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H. C. PARMELEE, Editor

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The Future of the Federated Societies

NEWLYWEDS are usually admonished that the second year of married life is the hardest—or perhaps it is the third—and that the first year of nuptial bliss will be no criterion of the permanence of their relations. It is after the glow of the honeymoon has faded and the bright light of a workaday sun has revealed the stern realities of the job that the danger of wreck or disaster impends. Somehow it is not easy to foresee, to project themselves into the future. Imagination is inadequate and realization comes with somewhat of a shock. In the crisis they either quit the game, disillusioned, or readjust and adapt themselves to life as they find it.

But it is not in domestic relations alone that the experience holds true. It is a factor in all human relations, whether for social, business or professional purposes. The first year is one of hope and expectation, ambition and determination; the second and third years bring the test of stability and permanence. And so it is that Federated American Engineering Societies, having been launched in a spirit of public service and having given a fair account of itself for a couple of years, finds itself facing the critical period of its existence.

In our judgment the crisis is largely psychological and arises either from a failure to appreciate the aims and purposes of the Federated or a tendency to expect and demand too much of it. In the first place the Federated was organized "to further the public welfare wherever technical knowledge and engineering experience are involved," to make the voice of engineers as a group articulate in public affairs. Hence there is no personal gain to be derived from membership in the Federated. It is not a question of what a member may get out of it, but what he is willing to put into it. It exists as a medium through which engineers may be of service to the public, not themselves. It is a case of giving, not receiving; and the measure of success of the organization is what it has done for the public welfare.

In the second place much of the work of the Federated is not spectacular nor does it appear with the regularity of daily, weekly or monthly routine. Hence, although the organization must justify its existence by its works, it can act only or mainly when there is a call for its services. It will not constantly have opportunities to look into industrial waste or study Muscle Shoals or make an investigation of the 12-hour shift. But it is there for just such purposes when the problems arise and can be financed—and that existence is an accomplishment in itself.

As we see the Federated, it is something to be perpetuated if engineers are to have a medium of expression on public mat'ers when occasion arises. It can help fulfill its destiny if it will adopt machinery to make the voice of the engineer articulate in public affairs by conducting referendums much after the manner of the Chamber of Commerce of the United States. Further, it must face its problems with courage and avoid the soft pedal in its work. And it must conduct its overhead and administrative affairs in the utmost economy, putting financial emphasis on productive work. Its membership, on the other hand, must continue unstinted support and not be too exacting in demands for productive activity. By all means let us continue the Federated and support it through this trying third year. Once the crisis is past and the organization has found itself it will justify its existence, not only among engineers but in the mind of the public for which it was organized. In the meantime let's get some action on that Muscle Shoals investigation, and look about to see what local industrial surveys can be made in medium-sized cities. If the engineers will investigate and supply the data, industrial and commercial leaders can be depended upon to translate them into action.

The Dangers of One Big Company

AT A DINNER of Group 8 of the New York State Bankers Association on Jan. 15 CHARLES M. SCHWAB said that in the 43 years he had been engaged in American industries, steel production had increased from 800,000 to 50,000,000 tons a year. "The greatest economy that can come to this country," he is reported as adding, "is manufacturing in as large quantities as possible and cutting the overhead. To have every steel works in one big company would be good, economically."

Mr. SCHWAB is a man of rare illumination and supreme ability. Usually we agree with him. But suppose such a super-organization were legally possible and practically feasible, who is there besides Mr. SCHWAB himself or Judge GARY with the ability to direct its affairs? The wrong man at the head means failure in part or in whole. But let's imagine the One Great Company established and the right man at the head. Although Mr. SCHWAB is a hearty, very human speaker, he measures his words. He said it would be a good thing economically, and we agree that the costs of steel would probably come down in some measure. But we doubt if it would be a good thing in any other respect, or even economically, in the long run.

How much the steel would sell for to consumers would depend in part on how much water the promoting bankers would pump into the new securities. If this were to absorb the economies, the whole thing wouldn't be worth while, except to the promoters. When Mr. SCHWAB took hold of the Bethlehem Steel Corporation he fought like a Trojan to have the preferred stock made non-cumulative as to dividends. He won his point after a hard struggle—and his foresight saved

him. It took long and weary years to develop the company.

Then, although the elimination of competition does away with a great measure of overhead expenses, as the speaker said, it permits low standards of material to be established. There is a nation-wide demand for better steel, better cement better materials for specific purposes. How could the One Great Company meet this demand with its ideals set on tonnage? The chance for improvement would be unfavorable. The One Great Company could do it—but would it? We think not.

We have no illusions of the blessings of competition. It has as many bad effects as it has good ones. But we believe it is the moderate-sized manufacturing concerns, that must strive for quality or quit, which have contributed most to improvements in the merchandise produced. As often as not it is their better quality of product which makes them grow great. Standard products are excellent in their way, but when we want something better we need to be able to get it.

No very big corporation can be administered without system and order. The bigger it is the more system must be established. But system is like competition: it has its merits and also its faults. Among the latter is its potency to destroy initiative. Under too much of it a great deal of the best talent withers and ceases to function. We get standard qualities and such betterments as are planned for, but all the illumination that would have come from the minds that wither as soon as they must proceed in goose-step is lost.

We hope the One Big Company may never be established.

In What Direction Goes Your Research?

SPEAKING in his own characteristic way, our good friend Dr. WHITAKER recently said: "At the end of 1918 we were like many other research organizations —going strong, but not in the right direction." He was referring, of course, to the disinclination for peace-time pursuits that had resulted from the craze for war production. It occurs to us, however, that quite often our research is inclined in the wrong direction. Permit us to give an example or two that may serve to make our meaning clearer:

The other day a friend, for whose technical ability we have the greatest respect, came to us and in one of his happy moments confided news of his recent successful research. Without divulging his secret, we can, for our present purposes, assume that he has discovered a new substitute for honey. His product looks like honey and tastes like it. Unfortunately it has no nutritive value, but it is harmless and, most important of all, not a single one of the usual chemical tests can distinguish it from honey. Furthermore, the product is cheap; it is made from corncobs. With it every apiculturist can turn out ten or a hundred jars of honey where only one, or maybe none, came before. Our friend's fortune is made, his invention is a success, but after all, what has he accomplished? He has merely invested his scientific talents in the forbidden field of adulteration; he has contributed nothing to the lasting good of his fellow men.

For our second example we must be permitted to draw a slightly different shade of meaning between the terms adulteration and sophistication. Research of rather questionable merit has carried us far in the latter direction. Not unnaturally many of our manufacturers have wanted to please the every whim and fancy of a whimsical public and to do this they have called for the help of the chemist. The soap maker, for example, wants to produce a white laundry soap because the housewife insists on such a product. In order to get it for her at a price she is willing to pay, the chemist is forced to add chalk or talc or some other inert filler in no small quantity. The addition of these materials helps to make a nice white product, but certainly it does not enhance the detergent properties of the soap. During the war some of us learned for the first time that large amounts of sugar were being used in making cheap transparent toilet soap, which has no advantage other than its appearance. However, the whim or fad of the customer is satisfied and that means business.

But it is not alone in the soap industry that the chemist is guilty of such connivance. The motorist, for example, demands a fuel that is without a disagreeable odor, that is bright and sparkling and will stay that way. Thanks to the chemist's wits such a product is available, but only after a refining process that adds to its cost and in some cases doubtless sacrifices its quality. Much the same condition exists in the field of lubrication.

Other examples might be adduced from practically all of our great industries, but these, we believe, are sufficient to point out a deplorable trend in some of our industrial research. The chemist himself may not be able immediately to correct this situation, but at the same time he should not lose sight of the fact that the greatest reward will come, not to the imitator or the mimic, but to the originator who leaves the beaten path and dares to search in new and untrodden fields.

Better Not Fool Ourselves

ABOUT a dozen years ago there was published a book called "All the Children of All the People," by WILLIAM H. SMITH, who was superintendent of schools in a Middle Western city. It is still in print, and well worth reading. Mr. SMITH'S contention is that we make a mistake in trying to mold all young people into one form by means of standardized curricula. As to that we have nothing to say in these columns, but his illustrations are very illuminating to those of us who have to administer affairs, or who aspire to do so.

Every one of us, claims Mr. SMITH, is short in some respects and long in others. We are born short and born long; both. There was an Irish-American hired man, brought up near the old Five Points in New York City, who could make any plant grow; but he couldn't learn to read or write. A boy, one of the author's pupils, could not learn the multiplication table and remember it. He grew to manhood, become an inventor and large manufacturer, achieved remarkable affluence —but never knew the multiplication table. In telling this to a leader of the New York Bar lately he remarked, "That's my trouble. I know some of the items, but not all; then I have to add or subtract to get my figures." The writer's brother, a man of rare intelligence and sound judgment, never could learn the sequence of the alphabet. He could rattle it off up to l, m—but there he always became confused. A very able teacher could not tell the time by the clock, and neither could an eminent judge. He carried a watch, but only for show. Another man who wrote and pub-

lished excellent verse that is recorded in the anthologies, and was an able United States Consul in a leading European city, could not do long division. An idiot girl, inmate of an asylum, who could not read nor even count, could make any kind of lace with a crochet needle, if she only saw the pattern. The list could be continued indefinitely. The point is that we are born both long and short and often remain so. If we are born short, we may master the subject well enough to pass, to get along; but we are bound to make a poor showing in competition if we specialize on our short suits.

Many of us are short in administration; born short and remain short. Indeed the vast majority of us suffer from this very lack. We see it proved in the many failures that occur as a direct result of faulty administration. And yet only a very few of us seem to know this. Administrative posts are well paid, and of course we want the pay. But we are so short in administrative intelligence that we are blind to our own defects; and we court failure and distress that we should gladly avoid—if we only knew enough.

It is not distinguished or agreeable or even honorable to boss a job unless one can do it well. Otherwise it causes misery all around and brings the onus of failure upon the man who undertakes it. It is not even profitable except for the little while it takes to prove the man to be no good. Surely it's better to do a thing well than to command others to do it. Why this false ambition to command? It is far better to look inward, to discover our real talents, and then to develop them and to rejoice in doing well that which we can do well. If we try seriously and try hard we can find out better than all the psychologists and mental testers together. But we shouldn't fool ourselves. We must be honest about it.

Indefinite Repetition Would Be Intolerable

THREE statements in the preliminary report of the Coal Commission express the essence of the public's interest in the industry:

"With resources of coal in the ground adequate for the needs of perhaps a hundred generations of Americans, the nation's coal bin is too often depleted and too often the prices paid for coal are much higher than seem warranted by the wealth of coal available."

"These experiences of unsatisfied demand and unsatisfactory prices have created in the popular mind a conviction that the natural benefits to be expected from a condition of plenty have been denied through artificial interference."

"The widespread public dissatisfaction with the service rendered by the coal industry is not confined to matters of shortage and price, for a train of unfortunate consequences has followed those recurring periods of scarcity: deterioration in the quality of fuel delivered; congestion of railway traffic, necessitating the neglect of other freight to give preference to coal, to the serious harm of other business; and breakdown of mutual confidence of producers and consumers of coal as expressed in the customary contractual relations."

And well does the commission add, "Every industry and every citizen throughout the country is directly or indirectly dependent upon coal." Of the dependence of the chemical and metallurgical industries there can be no question, for over a third of the entire bituminous coal consumption is by industries involving technical processes or chemical control. The commission then continues:

"It is clear that an indefinite repetition of these crises in the production and distribution of coal would be intolerable." This is a statement in which every branch of industry and every clear-thinking individual will concur.

It is not strange that the commission in less than three months has not been able to reach formal conclusions on the important problems presented to it. But it has made definite progress in establishing satisfactory fundamentals that require thorough investigation and some decision as to national policy. The main points of the preliminary report are very illuminating.

One of the causes of high prices of coal in some instances has been profiteering; the instability of the industry has been largely due to labor troubles; and car shortage at times of coal scarcity and high price is undoubtedly an important transportation deficiency. The commission discusses these three factors briefly, but passes on to the problem of over-development as apparently of equal or greater importance; and whether one considers that this over-development is itself a cause of the other troubles or a result of them is immaterial.

The effect of over-development is clearly shown by the commission to be an added cost to coal consumers for the maintenance of 200,000 miners and their families above the needs of the country for miners and the burden of capital charges on something like a billion dollars. It is high time that the national policy with respect to such matters as these be determined.

Very few will disagree with the query in the final paragraph of the report. All will simply hope that the right answer may be reached at an early date:

"The commission believes that the public interest in coal raises fundamental questions of the relation of this industry to the nation and of the degree to which private right must yield to public welfare. It may be that both private property in an exhaustible resource and labor in a public service industry must submit to certain modifications of their private rights, receiving in return certain guarantees and privileges not accorded to purely private business or persons in private employ."

Co-operation in Statistical Work

THE government is issuing at this time many requests to industries for a statistical report on their operations in 1922, looking forward to the annual reports on these industries. In some cases these questionnaires become so numerous and are so lengthy that one is tempted to throw them all in the waste basket in disgust. But in the long run that is poor policy.

The government through its careful, regular study of industrial operations of all sorts furnishes impartial, reliable statistics of great value. There is no industry which would not profit by knowing more of itself. The next time these questionnaires come, it will be well to stop and remember that it is the industry which is served, not any bureaucratic office or academic official.

Prompt, accurate and complete returns on the part of every operator will speed up the results greatly; and in work such as this, promptness in issuance of the data will add greatly to their value. It will be well to co-operate in work of this sort so that there need be no break in the continuity or question as to the reliability of the figures that are prepared.

Readers' Views and Comments

Why Not Get Away From Traditions?

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the Dec. 27 issue of *Chem. & Met.* Mr. Nasmith takes the phrase "Why not get away from traditions?" literally. The expression (not mine, by the way) did not suggest getting away from *all* tradition, but only from that which has a hampering influence.

It is evident that Mr. Nasmith is experienced in the baking art but in his defense of tradition overlooked an opportunity to explain why oven walls are built as thick as 25 in. He believes in the importance of "solid heat" and "flash heat," yet does not offer a definition of the terms. It is probably true that many points of disagreement would be cleared up or eliminated if disputants should at the outset agree upon definitions of terms.

In the case under discussion "flash heat" probably means the subjection of the goods to the action of the comparatively high temperature of radiant heat while passing over the fuel bed; this to get the "rise." "Solid heat" is probably what is termed in other industries "soaking heat," and is furnished by the hot gases; this is the baking heat.

An oven wall of 25 in. thickness is probably one extreme. The oven described as made of a steel shell covered with insulation is the other. Somewhere between these extremes is the correct design. As the brick walls exert a regulating or "flywheel" effect on temperature, only such mass of brickwork should be used as is consistent with this regulation and with the structural requirements. A wall thickness of 21 in. and 25 in. is, I think, quite as ridiculous as a steel shell insulated on the outside. The former has the advantage, however, in that the fault is one involving economics of construction and will not manifest itself to the operator.

A consideration of the specific heats, or heat capacities, of brickwork and the insulated-steel oven should suggest a brick lining in the latter of about two courses, or 9 in. More than this would be superfluous because of the low temperature involved (less than 600 deg. F.), and because the brickwork is heated on one side only and consequently cannot exert a maximum "regenerative" effect. One can be assured that the temperature found a few inches from the heated surface of oven brickwork can have no useful effect on baking; and even if the temperature were high enough the time required to make this heat available would be too great to assist in reducing rapid fluctuations of temperature within the oven.

The experience of the proprietor of the bakery who was forced to replace a new and efficient type of oven by an older and less efficient one, simply because the operators could not or would not operate it efficiently, illustrates a point raised in my first letter—that is, mental inertia. Some operators are of a bovine mentality and any departure from old practice is frequently resented. Often the resentment is followed by deliberate, but secret, efforts to "queer" the new apparatus. If this condition is to be met by surrender as in the case quoted, then progress may as well take off its hat and sit down.

I can appreciate the feelings of the operating staff of the chemical plant that was left with a monstrosity on the departure of the designing engineer. What seems curious is how he managed to do it. Where was the staff during construction? Was it the vogue to turn the design over to inexperienced men, and then fail to keep informed on what was being done? This looks more like clever salesmanship than honest-to-goodness engineering.

Because "the one in the arts who really knows cannot and does not express himself in writing," it does not follow that "the one who writes seldom does so from experience." Mr. Nasmith knows better than that.

Kansas City, Mo. C. O. SANDSTROM.

Galvanic Corrosion on Yacht Sea Call

To the Editor of Chemical & Metallurgical Engineering

SIR:—It may interest your correspondents A. Hough, Robert J. McKay and Henry Howard and your readers generally that a very similar case to that of the Sea Call occurred in Ceylon about 16 years ago. A passenger steamer was built by a well-known Colombo engineering firm to the order of a native shipping company, in conformity with specifications of the latter, which provided for a sheathing of sheet copper outside a steel hull, with the object of insuring a clean bottom in tropical waters. The vessel had been in commission for only a very short time when, on a voyage off the coast of Ceylon, the captain, noting her weird behavior, wisely decided to beach her. He barely succeeded in running her ashore when the corroded steel hull fell apart at the water line. An interesting lawsuit ensued between the shipping company as plaintiff and the contracting shipbuilder. The Supreme Court of Ceylon upheld the latter as not responsible for a defect arising from the customer's own specifications and not specifically provided against in the contract.

The trouble arose through the specifier ignoring the fact that electrochemical action ensues between two dissimilar metals in close proximity when, both touching, they are immersed in an electrolyte such as sea water. The already known protective action of copper plating was harmlessly effective in keeping wooden hulls clear of marine vegetation and barnacles, and no electrolytic action took place so long as only one metal was involved which was passive to sea water. In the case of an iron or steel vessel, however, copper is strictly inapplicable, because of the difference of electrical potential which sea water establishes between the copper and the steel, in virtue of which the steel assumes an electropositive condition and becomes eaten away in consequence, while acting as a generator of electricity which flows to the copper. The copper itself, being electronegative, is not acted on, and naturally suffers no corrosion.

In the case of the Sea Call the Monel metal would behave somewhat similarly to copper in relation to steel, and therefore, while corrosion of the latter would be

bound to take place, the homogeneous Monel metal would remain unaffected.

All such similar arrangements may be considered as the analogue of a simple galvanic cell, in which a zinc and a copper element are immersed in an acid solution or electrolyte. As is well known, the zinc is consumed in the action of such a cell, and so with iron, steel or any other electropositive element, but the copper or electronegative metal suffers no loss.

If any of your correspondents or other readers are interested further in the Ceylon case, I will gladly furnish them with more details.

PATRICK T. MACNAMARA.
Late Superintendent of Ceylon Telegraphs.
Brooklyn, N. Y.

Dirt in Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your editorial on "Dirt in Steel" in your issue for Jan. 10 stirred one of my friends to the point where he asked me to step into his chamber of horrors. What I saw would have caused a Ku Klux from Morehouse to bolt over the line into Arkansas. But as he (this friend, not the Ku Klux) is one of those retiring fellows who never break into print, he would not accept my suggestion that he write you himself. So when I left, I took some of his exhibits with me, concealed in my greatcoat.

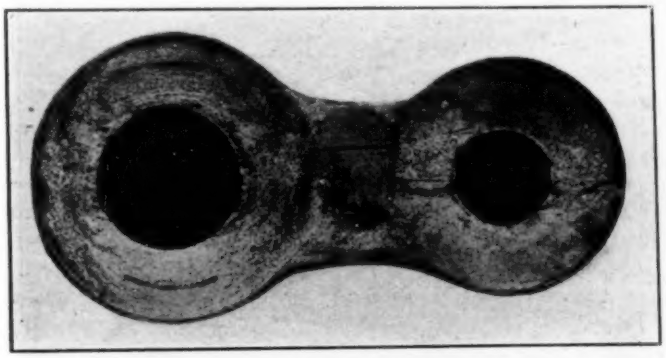


FIG. 1—SPRING SHACKLE, PICKLED. SOMEWHAT REDUCED

It appears that some spring shackles were giving a great deal of trouble—wearing out too soon or something like that. When they were sectioned and pickled as in Fig. 1, it showed that what steel there was, was segregated, but there was little steel—it was mostly slag. Note the slag in Fig. 2. No, Mr. Editor, this was not a casting.

I believe that in the Hartford region the first thing they do with troublesome steel is to pickle it 30 minutes in 1:1 HCl, and see the pock marks.

At another place my friend found that the shop had made some keys from a supposedly high-grade tool steel, yet they gave a great amount of trouble, cracking and shearing off. Fig. 3 shows the high-grade tool steel. No, Mr. Editor, it is not raisin bread or "spotted dog" of pleasant memory.

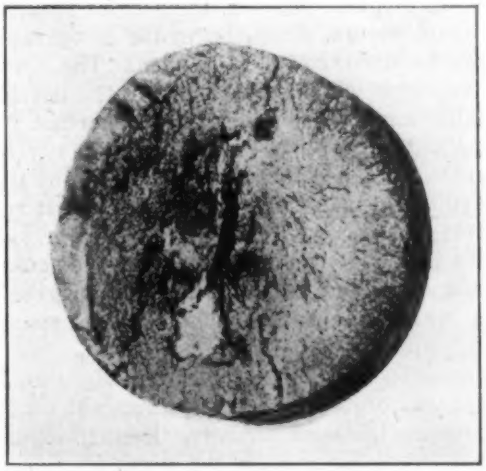


FIG. 4—FRACTURE OF ALLOY SHAFT

One of the most puzzling things was an alloy steel shaft. It was returned from the erecting shop, undoubtedly broken and of most extraordinary cross-section, looking like Fig. 4. Its analysis was O.K., and under the miscroscope it looked all right, too—properly sorbitic and all that. But when someone had a happy thought and repolished the section and looked at the steel again, he saw what is shown in Fig. 5. No, Mr. Editor, it is not an airplane view of the Allied trenches at Mons.

There was much more to the same effect, but this was all I could readily abstract without detection. It will suffice to give an idea of the tons of evidence you could find to support your main contention that many troubles with steel are not due so much to the metal as to the dirt.

MARTIN SEYT.

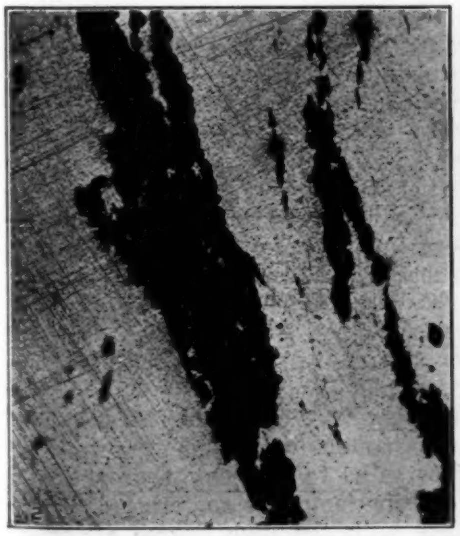


Fig. 2—Slag in spring shackle.

Fig. 3—Inclusions in tool steel.

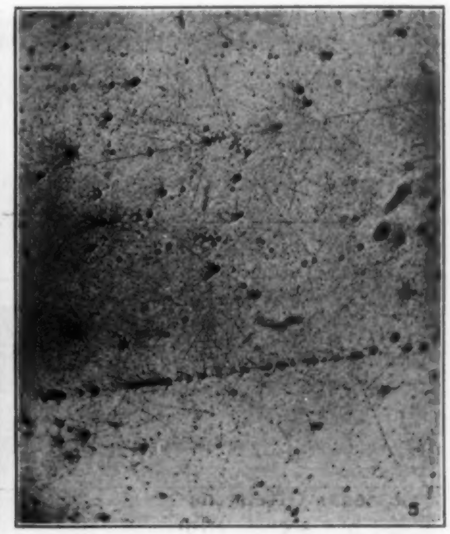


Fig. 5—Ranked dirt in alloy shafting

Manufacture of Spark Plug Porcelain

Porcelain Bodies Developed by Careful Scientific Research Are Formed Into Spark Plug Cores With the Aid of Specially Designed Semi-Automatic Machinery

BY ALAN G. WIKOFF

AS USED in the spark plugs of automobile engines, porcelain is required to withstand sudden changes in temperature without cracking or chipping and also to remain a good insulator even at increased temperatures. In airplane engines, the service requirements are even more severe, since the motor is operated continuously with the throttle wide open. The amount of scientific research which is required in the development of porcelains having the necessary properties for successful application in plugs is perhaps not fully realized until attention is called to the fact that one of the companies in this field maintains one of the largest research organizations in the entire ceramic industry. As the company is also a very large producer, a discussion of its methods will give an idea of the high degree of development which has been reached in the spark plug industry.

The Champion Porcelain Co., formerly the Jeffery Dewitt Co., was organized in Newark, N. J., in 1908 to manufacture complete spark plugs. In 1910 it moved to Detroit and as the demand for the spark plug porcelains grew it began to devote its entire efforts to the manufacture of porcelain, discontinuing the assembling of the complete plugs.

The Champion Spark Plug Co., of Toledo, became one of the largest users of these porcelains and finally, about 1917, its demand required the entire output of the Jeffery Dewitt Co.

In 1920 there was an amalgation of the two companies, the Champion Porcelain Co. now being a subsidiary of the Champion Spark Plug Co.

Ball clay, china clay, kaolin, flint and feldspar from a variety of sources form the raw materials for the porcelain body. An essential requirement is that each should be extremely low in iron. The first step in the manufacturing process is to combine the raw materials in such proportions that the resultant body will have as low a thermal expansion and will be as good an insulator at high temperatures as is possible with present knowledge. The batch composition necessary to give these properties has been determined only after thousands of experiments. In accordance with recent developments, the finished porcelain has a composition approaching that of sillimanite.

FIG. 1—WEIGHING BATCHES

Batches are weighed out as shown in Fig. 1 in amounts sufficient to form charges for the ball mills. A measured amount of water is added to each charge and the mill is operated for a definite period which is determined by the number of revolutions rather than by the time. In this way uniform grinding results are obtained. There are five 6-ft. Abbé pebble mills driven by individual motors through Link-Belt silent chain (Fig. 2). Porcelain mill-lining blocks and balls made in the plant are being used with excellent results.

The ground batch is dumped into agitators, where a uniform suspension is produced which is filtered through

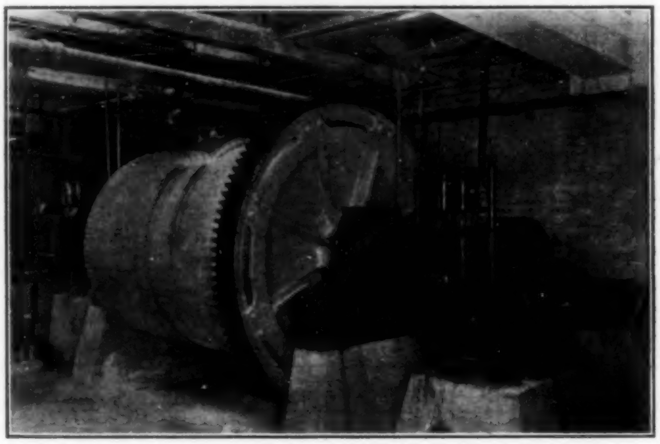


FIG. 2—PEBBLE MILL FOR GRINDING BATCHES

120-mesh lawn and then fed to the four Crossley filter presses, Fig. 3. The press cakes are piled on a skid and transferred by a lift truck to the horizontal pug mill shown in Fig. 4, in which any tendency toward segregation of particles in the press is overcome, the clay being discharged as a cylinder quite homogeneous in character.

Further improvement in the quality of the body is obtained by the process of aging. The clay is worked in piles, Fig. 5, by pounding with wooden mallets, Fig. 6. After the proper time has elapsed it is taken out on skids and pugged once more, this time in vertical American or Crossley machines, Fig. 7.

It is interesting to note that the only manner in which material can enter or leave the production department is by way of an elevator equipped with a Toledo platform scale so that a check can be kept without difficulty.

From the thoroughly pugged clay, cylindrical blanks about 1 in. in diameter with a ½-in. hole through the center are formed on Crossley vertical pug mills which have been rebuilt specially for this purpose. From these blanks the spark plug cores are made. Many difficult problems were encountered in attempting to redesign these machines so as to overcome segregation, lamination, uneven distribution of air and other defects which would interfere with the high degree of uniformity required.

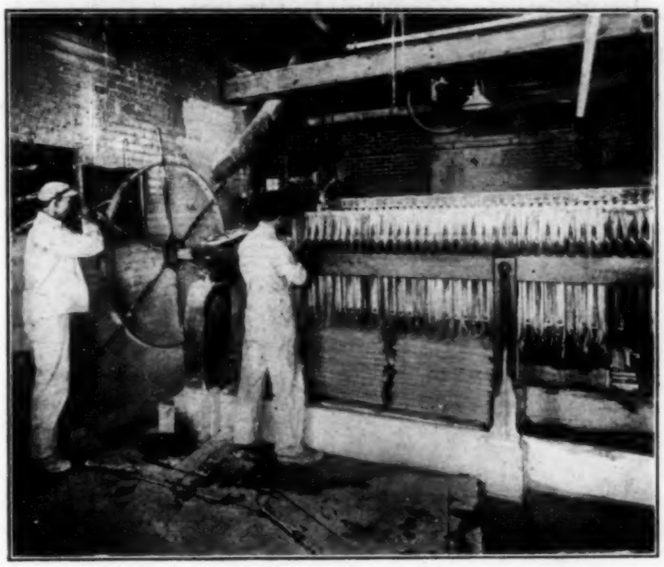


FIG. 3—FILTER PRESSES

As the perforated cylinder comes from the pug pieces of the required length are cut off by means of wires. Each of the twelve machines has a capacity of about 27,000 blanks per day. The blanks are placed on trays holding about 170 and allowed to air-dry for 24 hours in racks accommodating forty trays, before passing to the steam-heated tunnel drier. These operations are illustrated in Fig. 8. The racks are brought to the drier on a monorail hoist and rest on platform cars while passing through, Fig. 9. Temperature and time factors are adjusted so that all drying shrinkage or air shrinkage is removed. Control is maintained through a Tycos wet and dry bulb recording thermometer at the cold end, steam pressure recorder at the coils and a temperature recorder at the hot end of the drier.

Thorough drying brings the blanks to a condition which renders comparatively simple the operation of shaping. Specially designed grinding machines, Fig. 10, are used for this purpose. The blanks are placed on the spindles or on the centers depending upon the exact nature of the piece being made and rotated against a rapidly revolving silicon carbide wheel, the face of which is dressed to such a contour as to impart the required shape to the blank.

After receiving their external form the turned pieces are transferred to another position on the same machine and the petticoat is formed by counterboring with a formed tool which rotates at high speed. During this operation air is blown continuously through the bore in order to remove all dust. Both the turning and counterboring operations, however, are performed simultaneously.

The completed forms are placed on trays provided with suitable supports so that the forms are separated to prevent abrasion and chipping. Trays of dry blanks are sold to the girl operators and bought back on the basis of the number of perfect forms. One form in each tray is stamped with the batch number and the end is dipped in cobalt sulphate solution. On firing the form will develop a blue color, and as the capacity of a tray is the same as that of a sagger, each sagger will contain an easily distinguishable marker bearing the batch number.

Although the grinding operation is complete in considerably less than a minute, the blank has been reduced to about one-third of its original weight. Consequently, it has been necessary to provide for the removal of an amount of dust equal to approximately twice the output of finished product. This is handled by a twelve-unit

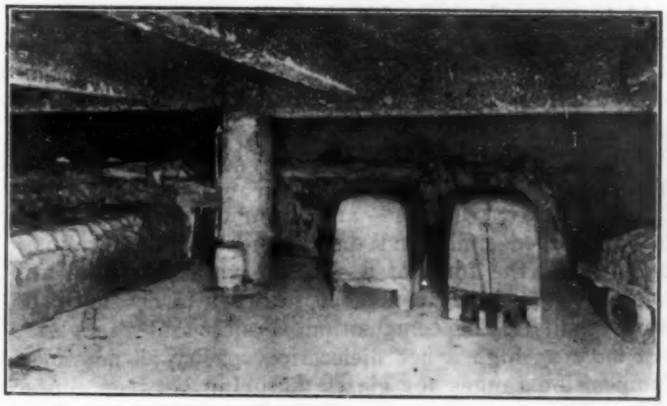


FIG. 5—AGING THE CLAY

dust recovery installation. The bulk of the dust accumulates in troughs under each row of machines, from which it is removed by means of a screw conveyor. The remainder collects in bags which are rapped automatically at intervals to remove the deposits.

When the amount of dust produced is considered, the almost complete absence of dust in the atmosphere of the grinding room is remarkable.

Owing to their special nature, it has been necessary

FIG. 4—PUGGING PRESS CAKES

FIG. 6—WORKING CLAY DURING AGING

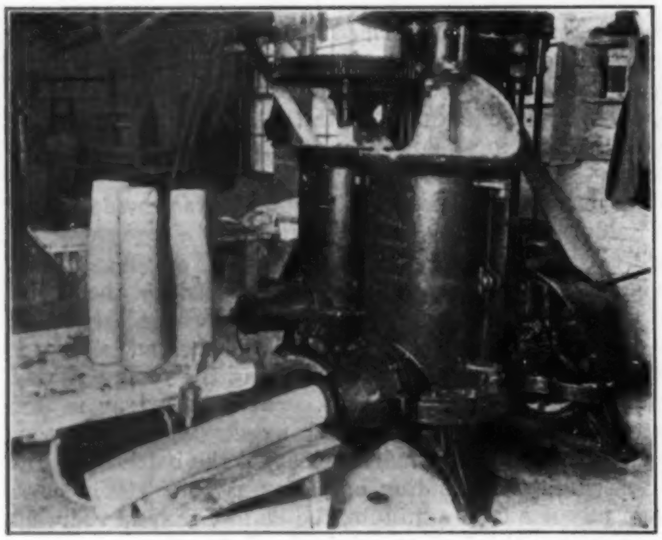


FIG. 7—PUGGING THE AGED CLAY

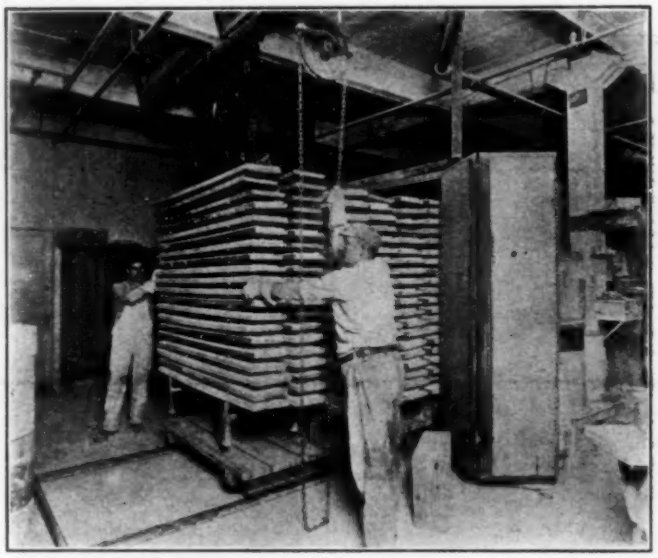


FIG. 9—TUNNEL DRIER

to develop and make the grinding machines within the establishment. An interesting variation is the machine used to make the balls for the mills. A small shop is devoted to the preparation of the grinding wheels, the surface being cut out on a lathe with a diamond-tipped tool guided by hand. Here also the worn wheels are redressed.

Application of a carefully selected glaze completes the operations prior to burning. The raw materials—clay, flint, feldspar, whiting — are ground very fine in porcelain-lined mills and distributed to the spraying machines in the form of a slip, the viscosity of which must be very closely controlled in order to obtain optimum results. The composition is such that the glaze will have as high a hot dielectric capacity as possible. Composition ranges for glazes maturing between cones 17 and 20, as set forth by Robert Twells, Jr.,[1] will give some idea of the formulas used for high-fire glazes.

Recently a method for selecting glazes within a field where all of the glazes appear equally suitable has been described by F. H. Riddle and J. S. Laird.[2] It was found that glazes which fit the body increased the tensile strength over that obtained for the unglazed body, while glazes which craze weaken the specimens very markedly. Appearance of the glaze alone is likely to be very misleading.

[1]*J. Am. Ceramic Soc.*, vol. 5, p. 430, July, 1922.
[2]*J. Am. Ceramic Soc.*, vol. 5, p. 500, August, 1922.

Spraying takes place on the ingenious machines shown in Fig. 11. Mounted on rapidly revolving spindles, the forms are carried past sprays of glaze slip so arranged that all parts receive an even coating with the exception of the shoulders, which would stick together in the saggers if glazed.

The glazed ware is set directly into a sagger—a round refractory container—as shown at the left, Fig. 11. A special composition applied to the inside bottom of the sagger provides a sticky surface which holds the forms upright and separated during the handling which precedes burning. In the kiln, the paste of course burns out, but the ware remains in place unless violently disturbed.

So severe are the burning conditions that the life of an ordinary fireclay sagger averages about one heat. Silicon carbide saggers have sufficiently greater life to more than offset the difference in first cost and are giving excellent service at the present time.

Periodic round downdraft kilns were formerly used exclusively for burning the spark plug porcelain. During 1919 a Dressler tunnel kiln was installed so that the periodic kilns are now in service only occasionally. However, it may be of interest to consider both types briefly in order to contrast the methods of burning.

Each of the six periodic kilns is equipped with eleven thermocouples (ten base metal and one noble element) connected with a Brown electric pyrometer. City gas is

FIG. 8—BLANK-FORMING DEPARTMENT

FIG. 10—CORE-GRINDING DEPARTMENT

used as fuel, the pressure being kept constant to within $\frac{1}{10}$ in. by means of gas boosters and regulators. Heating conditions are watched through twenty-one peep-holes, firing being continued to cone 17 down (1,470 deg. C.; 2,678 deg. F.).

Saggers are stacked in the kiln with a clay wad or seal between the rim of each sagger and the bottom of the one above it in order to exclude the products of combustion and also to enable the placing of each sagger in a level position so that the ware will not stick together. Setting and drawing are laborious operations, as the heavy saggers have to be handled on ladders in the upper parts of the kilns. Fig. 12 gives an idea of the drawing process.

For the Dressler tunnel kiln, which is of the muffle type, the saggers are set on cars as indicated in Fig. 13. The lower part of the cars consists of a cast-iron frame with roller-bearing trucks. Above this is a superstructure of refractory blocks which serve to protect the iron from excessive heat. The saggers are not placed directly on the car floor, but are supported on brick piers so as to permit free circulation, which is essential in this kiln.

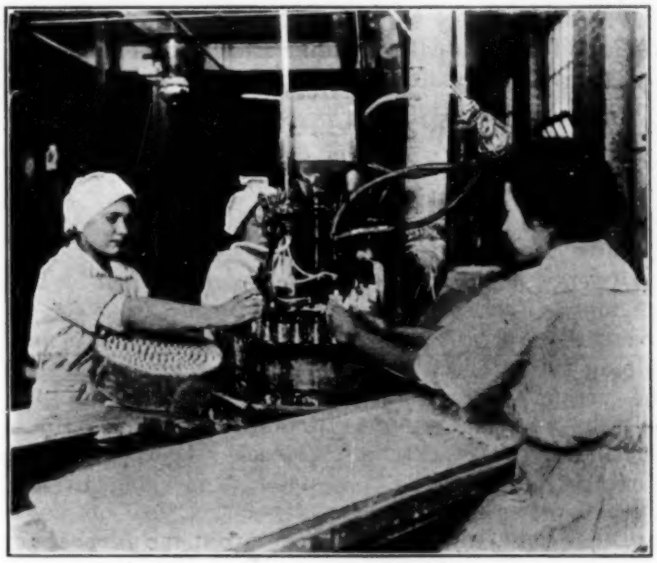


FIG. 11—SPRAYING ON THE GLAZE

The cars shown are at the loading and unloading station on the track which runs parallel to the kiln for its entire length. Before entering the kiln, the loaded cars must pass through the heavy guard at the right, Fig. 14, in order to make certain that there are no projections which might cause trouble within the kiln. A transfer truck moves the car in line with the kiln track.

As the kiln is always filled with cars—forty-eight in this case—the introduction of a car of green ware means the simultaneous removal of a finished car at the other end. Pushing mechanism powerful enough to move the train of forty-nine cars is provided in the form of a mechanical pusher. There are automatic control buttons which stop the cars should the pusher fail to stop when the proper point has been reached, thus preventing a car being pushed through the wall at the exit end. It is also impossible to push out a car until the transfer truck is in its proper position.

Operation is ordinarily on a 1-hour basis, that is, one car is entered and one withdrawn every hour, making the time of travel through the kiln 48 hours. A 1½-hour schedule has also been used.

The kiln itself is 305 ft. long with an arched roof or

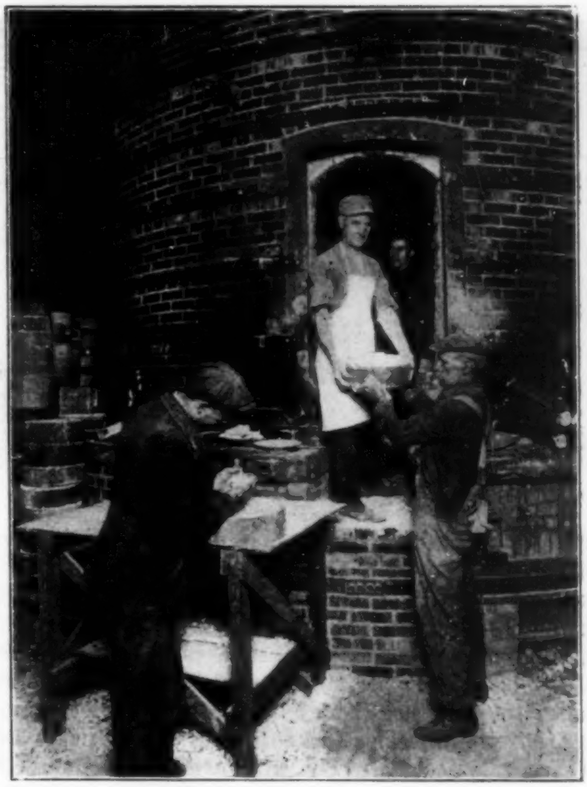


FIG. 12—DRAWING PERIODIC KILN

crown and platforms or bench walls on each side of the track corresponding in height with car floors. All arrangements for heating and cooling are supported on these platforms. The heating zone, Fig. 15, which extends from the mouth of the kiln to a point a little beyond the center, has horizontal combustion chambers on either side. For a distance of about 30 ft. in the zone of maximum temperature these chambers are built up of double-walled carborundum blocks assembled in a special trapezoidal form, Fig. 16. As the temperature diminishes toward the mouth of the kiln, the chambers are continued first with fireclay construction and then with iron pipes in the section nearest the entrance.

Combustion takes place near the center of the kiln and the products of combustion are drawn through the internal chamber toward the mouth of the kiln by an exhaust fan. Heat transfer takes place by conduction through the inner walls with radiation from the outer walls in the high-heat zone and also by convection currents set up in the channels between the double walls. As the combustion gases are not permitted to escape into the kiln, the character of the kiln atmosphere may be controlled as desired.

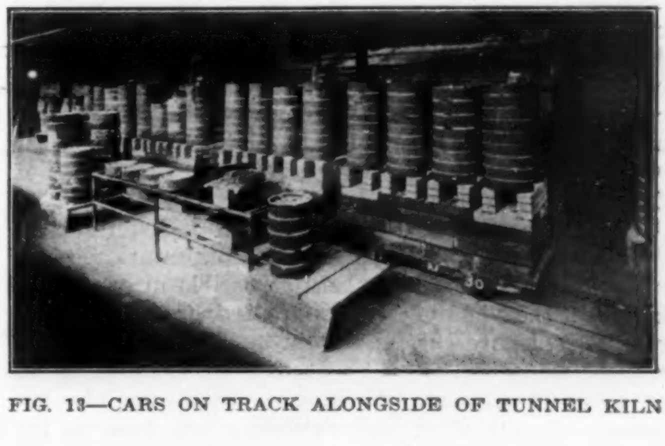


FIG. 13—CARS ON TRACK ALONGSIDE OF TUNNEL KILN

FIG. 14—LOADED CAR ENTERING TUNNEL KILN

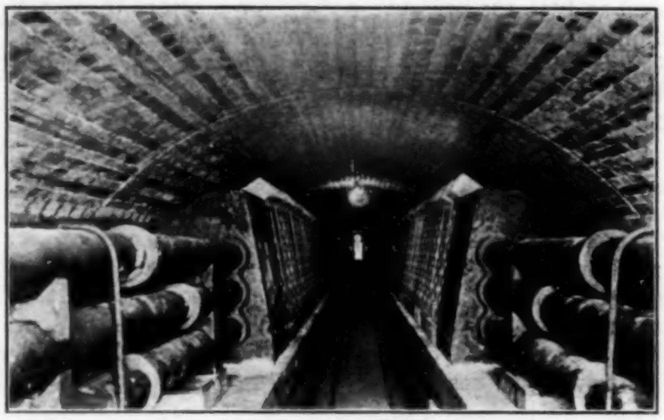


FIG. 15—HEATING END OF KILN

City gas is used as in the case of the periodic kilns. It is interesting to note that, so far as is known, this is the only kiln which is operating at from cones 18 to 20 down (2,714 to 2,786 deg. F.; 1,490 to 1,530 deg. C.). Being the first to operate at such high temperatures, this kiln has been experimental so far as the refractory lining of the high-heat zone is concerned. For the muffles, carborundum seems to be the only refractory which will give satisfaction. The kiln arch throughout the furnace zone is built of silica brick. The top and sides of the kiln are covered with insulating material. Further protection for the iron work on the cars is afforded by a series of water-cooling pipes extending along each side of the tracks through the furnace zone, a distance of about 75 ft. A sand seal is not necessary in this type of kiln.

During their progress through the heating zone, the cars of ware are brought gradually to the required temperature. Heat exchange between combustion flues and cars is such that on a 1½-hour schedule the combustion gases leave the kiln at 480 to 550 deg. F. This is lowered somewhat on a 1-hour schedule.

Leaving the high-heat region, the cars enter the cooling zone, Fig. 17, which constitutes the remainder of the kiln. From the discharge end of the kiln, cool air passes through pipes along the sides, absorbing heat from the convection currents, which are guided by the curtain wall shown at the right, Fig. 17. When this photograph was taken the left-hand curtain wall had not been completed, so that the cooling pipes are visible. Preheated air for the burners is obtained in this way, but there is also a considerable surplus which may be used for drying.

Since the cars move on a fixed schedule and it is thus impossible to give them individual attention as regards time of heating or soaking, uniform control of kiln conditions within rather narrow limits is essential for successful operation. Accordingly, a very complete set of indicating and recording pyrometers, draft gages, combustion meters, etc., has been provided. The operating installation is housed near the kiln, while another set for check and permanent record is located in one of the laboratories.

Because of the fact that temperature conditions in each part of the kiln remain constant, the ware receives more uniform treatment than is possible in a periodic kiln, and the yield of No. 1 ware is increased. Labor requirements are cut practically in half and the more efficient utilization of heat reduces the fuel consumption by about 70 per cent. Working conditions are also improved, since loading and unloading are done in the open on the track along the side of the kiln. With the periodic kiln the men inside must often work at uncomfortably high temperature, while the man in the doorway (Fig. 12) is in a strong draft.

Rigid inspection for dimensions and the possible existence of defects follows burning.

When thoroughly satisfied as to the quality of the product, it receives the familiar trademark. Formerly decalcomania—transfer paper bearing the design in the form of an inorganic pigment mixed with a suitable binder—was used, the design being fixed by firing to cone 015 (1,472 deg. F.; 800 deg. C.) in regular decorating kilns.

Now the design is applied by a rotating rubber stamp to the work, which is carried to it by a turntable carrying twenty spindles on which the work is placed by the operator. Each decorating unit, Fig. 18, consists of one of these printing machines and a tube furnace containing twenty electrically heated tubes through which the cores move much after the manner of cars in a tunnel kiln. As each piece is decorated it is placed in a slot in front of the tube. As each revolution of the turntable is completed a cross-head carrying twenty plungers advances and forces the entire row of plugs into the tubes, causing the ware within the furnace to advance a corresponding amount, thus discharging a row of finished plugs at the lower end. During the

FIG. 16—CONSTRUCTION OF ELEMENTS FORMING COMBUSTION CHAMBER

operation the plugs are heated to about 800 deg. C. and cooled down in a comparatively short time, so that this method constitutes an excellent heat test in addition to eliminating the handling required in connection with the decorating kilns. Five of these electrical units turn out the entire production, which is then shipped to the Champion Spark Plug Co., at Toledo, where the metallic parts are assembled with the porcelain to form the finished spark plug.

B. A. Jeffery, vice-president and active head of the production and service departments, is responsible for a great many of the special mechanical features which make the processes different from those used in the average plant and which have done much toward increasing the efficiencies of the various processes.

Research Departments

Without complete knowledge and intelligent application of fundamental scientific data, the production of modern high-grade ignition and high-tension porcelain would be impossible. No other organization in this field has shown greater appreciation of this fact, for Dr. Jeffery, president of the company, has built up a research staff of six highly trained technical men with nine assistants and has provided them with every facility for conducting precise investigations. The research department, which is under the direction of Frank H. Riddle, is made up of five laboratories—control, chemical, raw material, electrical and process. Ceramic research is also conducted here for the Jeffery-Dewitt Insulator Co., Kenova, W. Va., so that the latter company receives the benefits of this highly-developed organization.

FIG. 17—COOLING END OF KILN

In the control laboratory, Fig. 19, the blue markers from each sagger are subjected to test before the rest of the plugs are released for shipment. Here also experimental bodies are tested before the batches go into production.

For the continuous-heat test, the plugs are mounted on the rim of a horizontal disk which in rotating passes them through a stream of cold air and then through the flame of a Meker burner. This apparatus will be seen on the table beside the bookcase at the left. Heating the plugs for 1 minute over a Meker burner and rapping them sharply while hot constitutes the 60-second test.

Against the wall in the background is the equipment for the hot dielectric test. A constant voltage is passed through the plug while it is being heated in an electric muffle furnace and the temperature at which the porcelain ceases to be an insulator is recorded. Leakage is shown on an indicating wattmeter. The present product cuts out quite regularly at 1,700 deg. F. Maintenance of a constant voltage presented a problem which was finally solved by converting alternating current to direct current and back to alternating current again with regulators on each step.

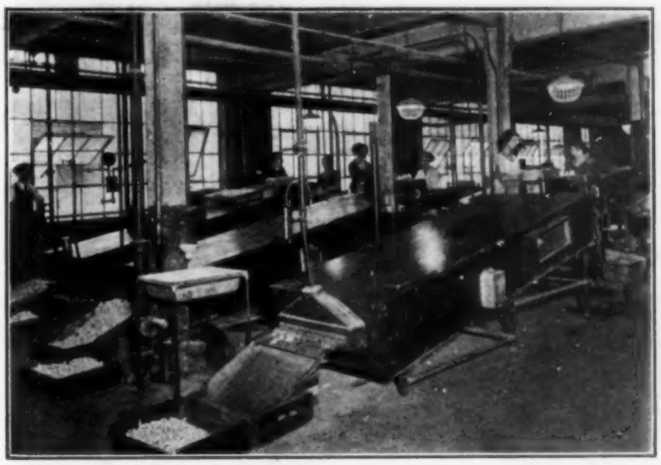


FIG. 18—DECORATING UNITS

Impact tests are made by placing the plug in a holder so that one end protrudes and subjecting the exposed part to blows from a steel hammer which slides on a vertical graduated rod, seen on the corner of the table at the extreme right. The weight is dropped from a noted height and if breaking does not result, the operation is repeated from the next higher graduation and so on until the specimen breaks.

On the table in the center of the picture is a 2,000-lb. Olsen cement-testing machine provided with special grips for determining the tensile strength of porcelain.[3] The test specimens have either conical or dumb-bell shoulders, and the central portion of minimum cross-section is left free from glaze to avoid the effect of the glaze in increasing or decreasing the strength of the specimen. The recording instrument room for the Dressler tunnel kiln is also part of this laboratory. Structure of the finished product is studied by means of an excellent petrographic microscope.

[3]See "The Tensile Strength of Porcelain," by F. H. Riddle and J. S. Laird, *J. Am. Ceramic Soc.*, vol. 5, p. 385, July, 1922.

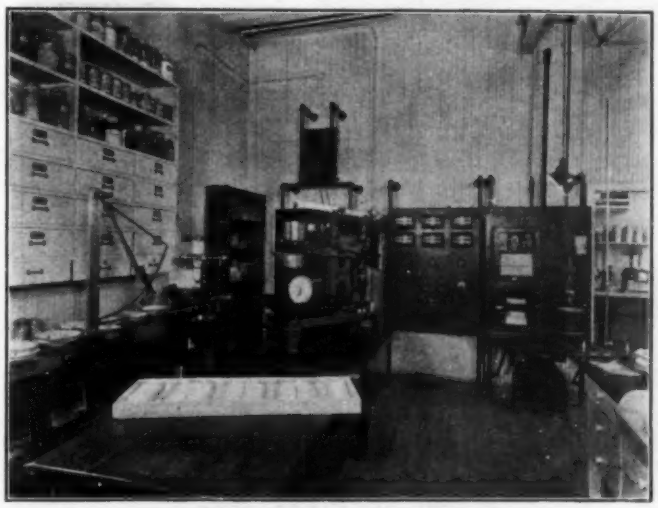


FIG. 19—CONTROL LABORATORY

FIG. 20—RAW MATERIAL LABORATORY

Equipment for complete silicate analysis is provided in the chemical laboratory, which also has a comparometer and a Joly balance for specific gravity determinations.

In what may be called the raw material and production batch following laboratory, screen analyses up to 300 mesh are made on each mill charge, shrinkage is determined on each press cake and a record of firing on raw materials is filed. Fig. 20 shows part of this laboratory, with the mercury volumeter for determining shrinkage, fired clay disks, feldspar cones, and viscosimeter at the right. The firing tests on raw materials are filed in the cabinet at the left.

A continuous production record is kept, in which progress of the batches through the various manufacturing processes is indicated by colored lines, a different color being used for each batch.

One of the primary functions of the electrical laboratory is to make and calibrate thermocouples. The calibration outfit is of the Bureau of Standards potentiometer type. There is also a very sensitive device for determining the thermal expansion of porcelain heated in a Crisco bath. An electrically heated apparatus now in process of development will enable this determination to be made at 1,000 deg. C. Measurements of electrical conductivity and dielectric properties can also be made.

FIG. 21—PART OF MECHANICAL AND ELECTRICAL LABORATORY

Since much of the special apparatus is best made within the department, a small but well-equipped machine shop has been included. This is shown in Fig. 21, with some of the electrical equipment at the left.

As far as possible, the process laboratory (Figs. 22 and 23) contains one unit of each type of machine in the plant so that development work can be carried right through to large-scale units without interfering in any way with the production departments. It is thus possible to know beforehand exactly how a new body will behave when placed in production.

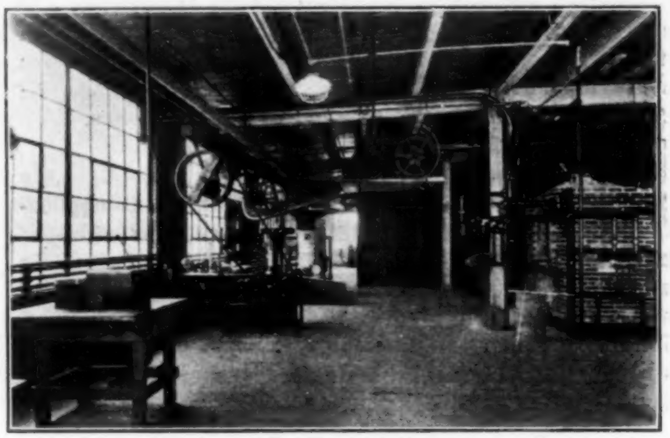


FIG. 22—FURNACE END OF PROCESS LABORATORY

The inclusion of a full-sized pebble mill would be out of the question, of course, but a number of small ball mills have been calibrated accurately in terms of larger plant units.

Along the window side of the laboratory (left, Fig. 22; right, Fig. 23) there is the following equipment: A full-size pug, a half-size pug, a glaze sprayer and a grinding unit of five machines. In the background at the left of Fig. 23 is a drier with complete temperature and humidity control, while the surface combustion furnace which duplicates kiln conditions as nearly as possible is shown at the right, Fig. 22. There is also a small surface combustion furnace with alundum crucible on which it is possible to reach cone 36 (3,362 deg. F.; 1,850 deg. C.).

FIG. 23—GENERAL VIEW OF PROCESS LABORATORY

For determining porosity, the fuchsine penetration test is used. Fuchsine dissolved in methanol (because

this solvent will absorb many times its own volume of air) is forced into the porcelain under high pressure. Upon breaking the specimen, the penetration, if any, is easily observable.

Preliminary lots of blanks where the quantity is too small for the pug are thrown by hand on a wheel.

All pyrometer protection tubes used in the plant are made in this department, a tube press, casting racks and molds being provided for this purpose. The results have been so satisfactory that experiments are being conducted toward the commercial production of these tubes.

It would be difficult to find a plant in which co-operation between research and production departments is more complete, and the results which have been obtained speak for themselves regarding the value of such co-operation.

Data and illustrations for this article were made available through the courtesy and assistance of Dr. J. A. Jeffery, president, B. A. Jeffery, vice-president, and Frank H. Riddle, director of research.

Theoretical Derivation of the Vapor Pressure Curve of Xylol

Novel Method of Calculating the Curve by Studying the Vapor Pressure Curves of Its Homologs

By Dexter C. Edwards

A SEARCH of the literature of coal-tar products showed a large number of determinations of the vapor pressures of benzol, toluol and naphthalene at various temperatures, but no figures were available for the vapor pressure curve of xylol. Since it was desired to have a close approximation to this curve for some experimental work, an attempt was made to derive it theoretically.

The line of reasoning back of the scheme adopted was as follows: All substances have zero vapor pressure at the temperature of absolute zero. Likewise all substances have a vapor pressure of 760 mm. of mercury at their boiling point. The next step in the reasoning was that, though the relative paths followed between these two points varied, yet for any particular class of substance this path would be the same in its relative proportion.

Vapor pressure curves were then plotted for benzol,

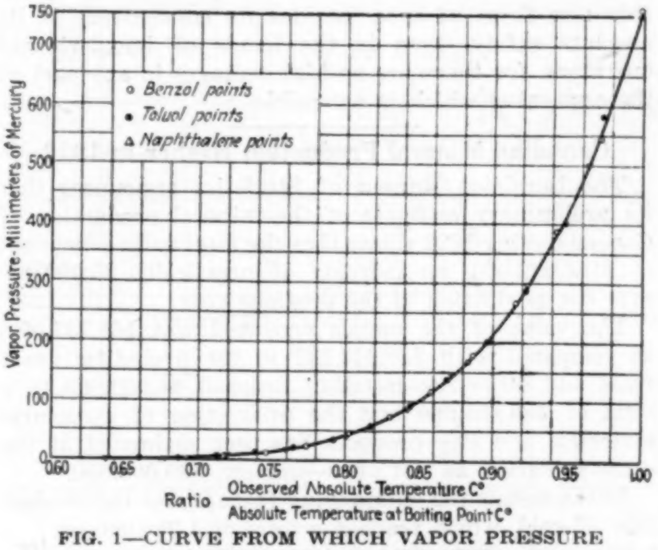


FIG. 1—CURVE FROM WHICH VAPOR PRESSURE OF XYLOL WAS CALCULATED

toluol and naphthalene from the data available for these substances in Landolt-Börnstein, Beilstein and other sources, all values given being used and the curves drawn through the average of these points. These curves were plotted between Centigrade degrees and millimeters of mercury. Separate large-scale curves were plotted for the lower range of temperatures in order to be able to read accurately the corresponding vapor pressures. From these curves, the vapor pressures for these three substances at definite temperatures were obtained. These data are given in Table I. Then the absolute temperature for each of these temperatures was placed in the adjacent column. The next column contains a row of figures obtained in each case by dividing the corresponding absolute temperature by the absolute temperature of the particular substance at its boiling point.

TABLE I—VAPOR PRESSURES FOR BENZOL, TOLUOL AND NAPHTHALENE

Benzol

1 Deg. C.	2 Deg. C., Absolute	3 Absolute Deg. / Absolute B.P.	4 Vapor Pressure mm. Mercury
—20	253	0.717	6
—10	263	.746	13
0	273	.774	25.8
+10	283	.802	45.2
20	293	.830	75.0
30	303	.858	118.7
40	313	.887	181.1
50	323	.915	269.0
60	333	.943	388.6
70	343	.972	547.4
80 B.P.	353	1.000	760.0

Toluol

1 Deg. C.	2 Deg. C. Absolute	3 Absolute Deg. / Absolute B.P.	4 Vapor Pressur mm. Mercury
—20	253	0.661	1.7
—10	263	.687	3.5
0	273	.713	7.2
+10	283	.739	13.3
20	293	.765	22.5
30	303	.792	36.0
40	313	.817	59.0
50	323	.843	92.5
60	333	.869	140.0
70	343	.896	203.0
80	353	.922	288.0
90	363	.948	404.0
100	373	.974	582.0
110 B.P.	383	1.000	760.0

Naphthalene

1 Deg. C.	2 Deg. C., Absolute	3 Absolute Deg. / Absolute B.P.	4 Vapor Pressure mm. Mercury
—20	253	.515	....
0	273	.556	....
+20	293	.597	....
+40	313	.638	0.2
60	333	.678	1.9
80	353	.719	7.1
100	373	.760	18.9
120	393	.801	42.2
140	413	.842	88.0
160	433	.883	170.0
180	453	.923	298.0
200	473	.964	500.0
218 B.P.	491	1.000	760.0

The derived value of the ratio of the absolute degrees Centigrade at any point, divided by the boiling point of that substance in absolute degrees Centigrade, as shown by column 3 in each table, is plotted against the corresponding vapor pressure, on the curves in Fig. 1. These points are seen to fall on the same curve, when drawn on this scale, so the variation in any case would not be very great.

Since this curve shows that these three substances have the same shape vapor pressure curve, then it is logical to assume that the vapor pressure curve of xylol should have this same shape. This being true, it is possible to work backward to the vapor curve of xylol. For this purpose it is necessary to assume a boiling point for xylol. The figure chosen is 140 deg. C., which

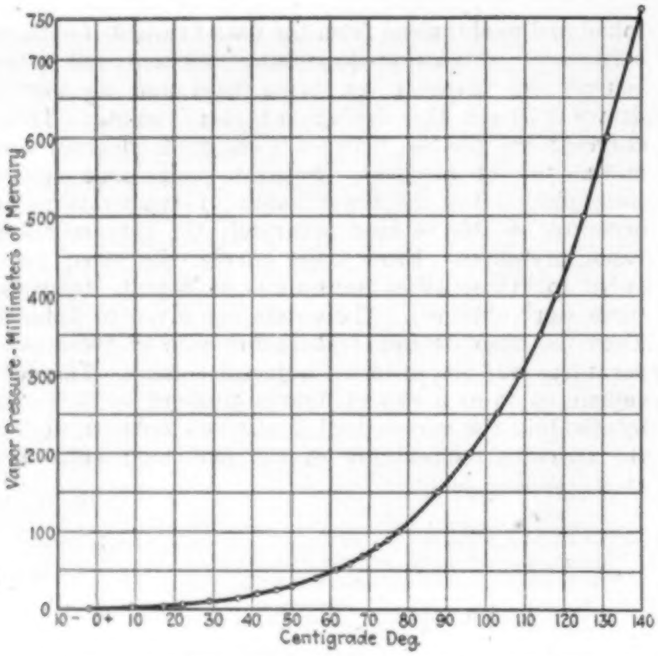


FIG. 2—CALCULATED VAPOR PRESSURE CURVE OF XYLOL

is about the average of the three isomers, ortho, meta and para xylol. Next, a column of vapor pressures is set down as shown in column 1 in Table II. The values for the ratio corresponding to these vapor pressures are next obtained from the curve drawn from the data in Table I. These are placed in column 2. Each of these ratios is then multiplied by the absolute boiling point of xylol, 413 deg., thus producing the figures shown in column 3. These figures, less 273 deg., are the corresponding temperatures in Centigrade degrees, and are shown in column 4.

TABLE II—VAPOR PRESSURES OF XYLOL

	Xylol		
1	2	3	4
Vapor Mercury	Absolute Deg.		
mm. Mercury	Absolute B.P.	Deg. C. Absolute	Deg. C.
1	.657	271	— 2
3	.683	282	+ 9
5	.702	290	17
7	.715	295	22
10	.731	302	29
15	.749	309	36
20	.762	314	41
25	.773	319	46
30	.782	323	50
40	.797	329	56
50	.808	334	61
60	.817	338	65
70	.827	341	68
80	.836	345	72
90	.843	348	75
100	.849	351	78
150	.875	361	88
200	.894	369	96
250	.911	376	103
300	.924	382	109
350	.936	387	114
400	.946	391	118
450	.955	395	122
500	.963	398	125
600	.979	404	131
700	.992	410	137
760	1.000	413	140 B.P

The values in columns 1 and 4 of Table II are then plotted and produce the vapor pressure curve for xylol, shown in Fig. 2.

The writer frankly admits that he knows of no law permitting the assumptions made above. But owing to the fact that the three coal-tar substances benzol, toluol and naphthalene followed the same relative curve as is shown, it was thought safe to assume that xylol would behave the same way. In any case, the resultant error should be quite small.

Methods of Controlling Electron Currents in High Vacuum*

Most of the applications of high-vacuum tubes have depended upon the control of electron currents, as for example by the grid in the three electrode tube. The action of the grid is due to the charge on the grid modifying the space charge effect. This is the action that is employed in practically all tubes used today for radio transmission and receiving. There are many other methods, however, of controlling electron currents. A very important method is that used in the magneton, where there are only two electrodes in the evacuated space and the control is obtained by means of a magnetic field generated by an external coil of wire. A still simpler form of magneton suitable particularly to very large power tubes consists of a very large filament in the axis of a cylindrical anode with very large straight filaments. The magnetic field produced by the current through the filament is enough to prevent electrons flowing between cathode and anode. By heating the filament with alternating current, the current periodically falls to low value and at these times current can flow to the anode. This gives a pulsating or oscillating current, which can be used for radio transmission. A 1,000-kw. tube of this kind is in process of development; preliminary tests have been in every way satisfactory.

Another form of tube by which electron currents can be controlled is the Dynatron. This depends upon subjecting one of the three electrodes in the tube to electron bombardment in such a way as to cause electrons to be splashed out of it, just as water can be splashed out of a cup by attempting to fill it too rapidly from a faucet. A tube of this kind acts like a real negative resistance, and can be used for producing electrical oscillations with considerable efficiency.

One of the most important applications of electron discharges from hot cathodes is in the Coolidge X-ray tube which is now almost universally used as a source of X-rays. These tubes were first made about 1913 and are gradually being improved in many respects. The latest type of tube, suitable for use by dentists, is a small tube weighing only a few ounces and only about 3 in. long. Because of the special features of this tube, the entire X-ray outfit, including the transformer, lead screen, regulating apparatus, etc., weighs only a few pounds and takes up a space of only a small fraction of a cubic foot. One very great advantage of this new form of tube, besides its convenience is its absolute safety, even in the hands of inexperienced operators, for there are no high voltages in any part of the apparatus which is accessible.

Canadian Mineral Production Higher in 1922

The Dominion Bureau of Statistics announces that its preliminary estimate of the mineral production of Canada during 1922 shows that the total value amounted to $180,622,000, an increase of practically $6,000,000 over the production of the previous year.

The value of the metals produced was $61,731,000, as compared with $49,343,232 in the preceding year; fuels and other non-metallics dropped $4,000,000 to a total of $83,891,000 and the production of structural materials and clay products has been estimated at the same valuation as last year—namely, $35,000,000.

In the metals the outstanding feature was the production of gold, which reached a total of 1,200,000 oz.

*Abstracted from a lecture by Dr. Irving Langmuir, Pittsburgh, Pa., Nov. 28, 1922.

Effect of Chemical Solutions On Various Woods Used in Tanks

By S. J. Hauser and Clarence Bahlman
The Hauser-Stander Tank Co., Cincinnati, Ohio

What Kind of Wood Can We Use With Such a Solution?—In What Way and How Extensively Do the More Common Chemicals Affect the Most Industrially Important Woods? — These Questions Are Comprehensively Studied in This Article

Although wooden tanks have been extensively employed for containing chemical solutions, little attention has been paid to the kind of wood best suited for any specific liquid. Very often a manufacturer hesitates to purchase wooden tank equipment because both he and the tank builder are uncertain as to the ability of the material to withstand the action of the solution in question. With this in mind, the writers undertook to determine, in a limited way, the effect of various chemical solutions, in varying concentrations and at different temperatures, upon the more important woods used in tank construction. It was not expected that these experiments would solve all of the problems, but it was believed that much valuable light might be thrown upon the subject.

Of course, the life of a wooden tank, or vat, in industrial use is governed not only by its resistance to the contained chemical but also by the skill and care used in its construction as well as the way it is used and the care given it by the plant operatives. Laboratory experiments alone may not definitely determine which wood is most suitable for a specific purpose, inasmuch as practical experience and the various physical properties and defects of the different woods have a great influence in the proper selection; still they are a wonderful help in making a decision. Very often laboratory results assist materially in explaining the failure of a wooden tank on the one hand and help to avoid future failures on the other.

We therefore feel justified in submitting our results, incomplete as they are in a somewhat condensed form, believing that they will furnish a clearer conception of just what might be expected of certain tank woods when exposed to chemical solutions.

The following six woods were used in these experiments: red gulf cypress, Douglas fir, long leaf yellow pine, California redwood, hard maple and white oak. Uniform test strips (4x1x¼ in.) were prepared from thoroughly air-seasoned lumber and only such pieces as were free from knots and other defects were employed in the experiments.

Our experiments were confined to a study of the effect of various hot and cold solutions upon the different woods, determining the absorption of the liquid, expansion or contraction of the wood and other physical action such as softness, brittleness, warping, etc. Also, the relative amounts of color and taste imparted to water by the various woods were recorded. The strips were completely submerged and a separate container was used for each kind of wood.

The common acids, alkalis and salts, as well as linseed oil, turpentine and distilled cottonseed oil fatty acids were employed. For absorption and expansion or contraction the strips were weighed and calipered, then immersed in the cold solution for a week, when examinations were made again. After this they were returned to the solution for 3 weeks more and the physical examinations were made. Where hot solutions were used the strips were immersed for a week, and each day the solutions were brought up to boiling for 1 hour. Tests were also made on strips coated with asphalts, pitches and various so-called acidproof paints.

After the desired period of immersion, the strips were removed and dried on the outside with a rag, and then permitted to remain for 15 minutes exposed to the atmosphere before weighing or calipering. The increase in weight was expressed as grams absorbed per strip—i.e., per cubic inch — and also as percentage gain in

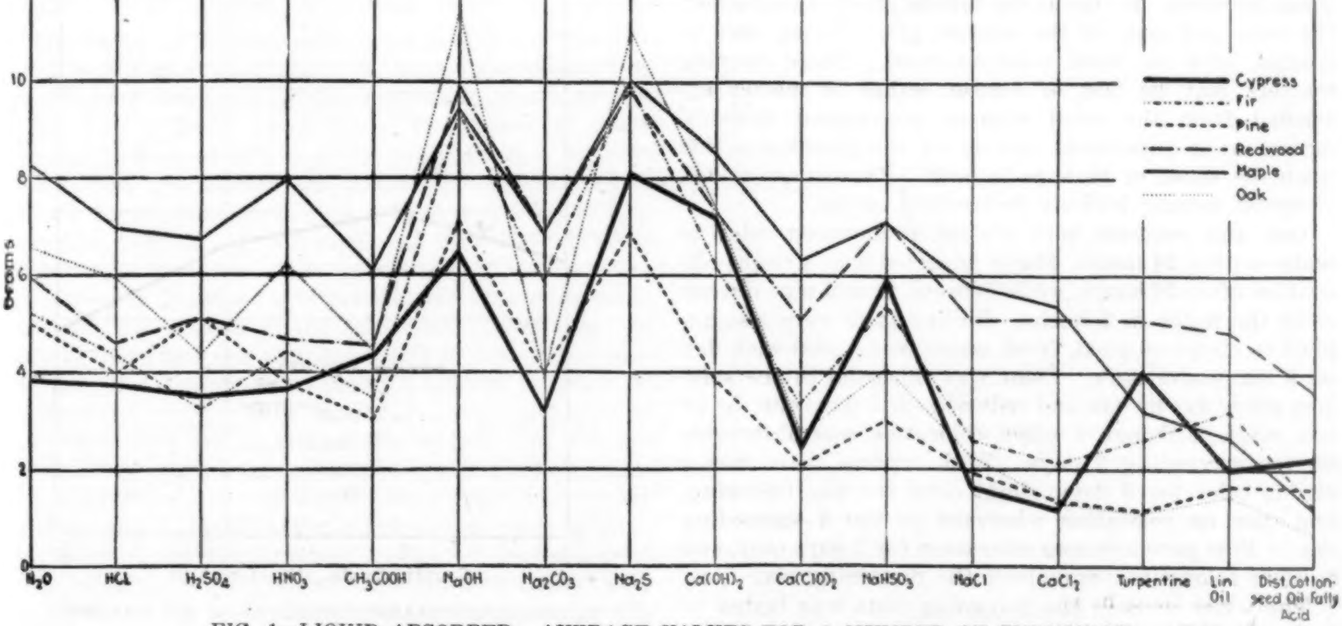


FIG. 1—LIQUID ABSORBED. AVERAGE VALUES FOR A NUMBER OF CHEMICALS

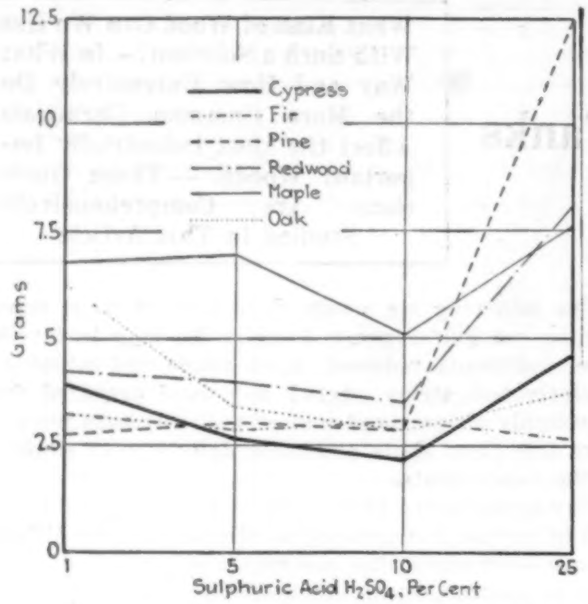


FIG. 2—LIQUID ABSORBED. H_2SO_4 AT VARYING CONCENTRATIONS

weight. The increase or decrease in dimensions at this point was designated as Temporary Expansion or Contraction. The strips were then permitted to dry under atmospheric conditions for one week, after which they were calipered again, and this result was expressed as Permanent Expansion or Contraction.

After these examinations were made, the strips were returned to their respective solutions and kept submerged for 3 weeks more, when they were removed and their physical condition noted. A record was also kept of the color imparted to the liquid. With the hot solutions, instead of waiting 15 minutes after removing the strips therefrom before weighing or calipering, they were weighed and measured shortly after removing the excess liquid and drying with a rag.

Experimental Results

Effect of Wood Upon the Solutions—Obviously there are two effects for which we would be on the lookout in these experiments. One is the effect of the wood upon the solution, and the other is the effect of the solution upon the wood. So far as the former effect is concerned, the color and taste of the solution after having been in contact with the wood were observed. These coloring matters may be due, of course, either to matter extracted from the wood without pronounced chemical action, or to substances formed by the chemical action upon the wood, or perhaps to both. Pronounced colors, however, usually indicate destructive action.

Oak and redwood both yielded pronounced color to water within 24 hours. Maple imparted only a slight coloration after 48 hours, while cypress, fir and pine did not color the water in 2 weeks. Boiling tests were also applied to strips of wood, fresh water being used each day on 8 successive days. Color was imparted to the solution every day by oak and redwood, on 5 days only by fir and maple, although a slight coloration was observable on the succeeding 3 days. With cypress there was a strong color for 3 days, slight color the day following, and then no coloration whatever on the 4 succeeding days. Pine gave a strong coloration for 2 days only, and a slight coloration throughout the remaining six.

The water used in the foregoing tests was tasted in each case and it was found that boiling water intensified the taste but gave the same general resuts as follows: Pine gives a pronounced taste to the water throughout the test, whereas cypress gives none at all. It can be concluded from these tests that cypress, inasmuch as it imparts neither taste nor color to a solution, would be easily the best wood to use for making tanks for food products.

With acids and alkalis, the colors extracted from the woods vary somewhat with the strength of the chemical used, but in general gave the same order of receptivity, cypress giving the least color, the redwood and oak the most.

The Effect of the Solutions Upon Wood—It is, of course, nearly impossible to get any absolute standard of reactivity of a given solution upon a given wood. Therefore some rather empirical standards have been adopted. The first is the quantity of liquid absorbed by the wood, and the second is the expansion or contraction of the strip of wood during the action. In addition, of course, there are also the appearance and physical conditions of the strips themselves aside from any quantitative measures.

Quantity of Liquid Absorbed

The results of the many tests have been condensed into charts and tables, and it is hoped that the type of results obtained may be interpreted from these charts. Fig. 1 shows the amount of liquid at room temperature absorbed in grams by the strips of wood. The results of the different concentrations have been averaged and the points represented on the chart are therefore average points. In general it will be noted that the curves seem to vary somewhat similarly. In other words, one solution is more readily absorbed by all the wood than another solution. In general too it will be noted that maple and redwood absorb more than cypress. A good many other interesting minor points can be observed by studying the chart, but it must be borne in mind that the tests are not absolute tests and the results are recorded in empirical units.

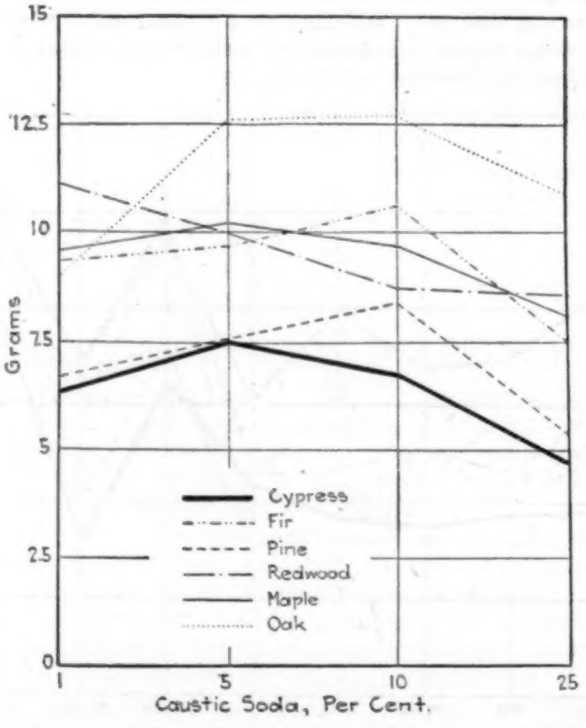


FIG. 3—LIQUID ABSORBED. NaOH AT VARYING CONCENTRATIONS

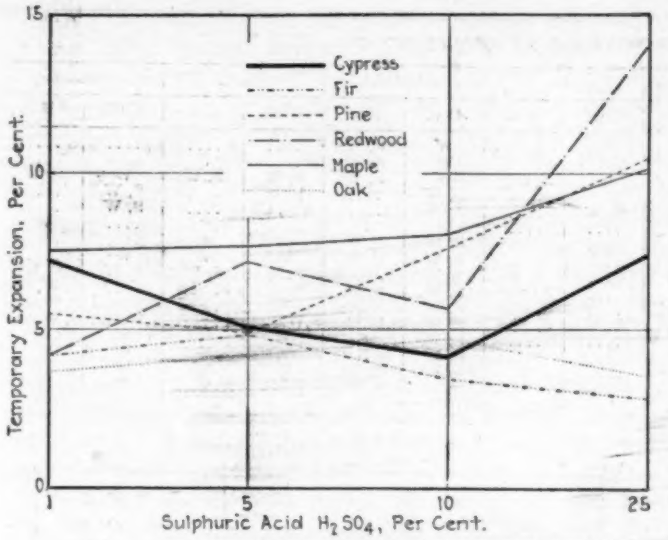


FIG. 4—EXPANSION IN H_2SO_4 AT DIFFERENT CONCENTRATIONS

However, it is certainly true that corrosion should vary somewhat directly as the amount of liquid or solution absorbed, and one would expect, therefore, to find more corrosion and disintegration of the wood which absorbs more of the solution. The results obtained with hot liquids are not given here, but were similar to those obtained with the cold liquids, as a rule greater absorption taking place with the hot liquids, although there were a few exceptions to this rule.

As was stated above, the values for any one wood in a given solution are average values, and it may be added here that as the concentration of the solution increased, the quantities absorbed varied irregularly. This was in some ways a surprise, for it was expected that the absorption would either increase or decrease as the strength of the solution varied. To bring this point out more definitely, Figs. 2 and 3 represent the effect of varying concentrations of sulphuric acid and caustic soda on the different woods used. It is perhaps significant to note that the general shape of the curve is in each case somewhat identical, but more quantitative conclusions are probably not warranted. Similar results were also obtained with hot solutions and with other chemicals not listed.

Expansion and Contraction

Variations in the contraction or expansion of the different woods used were also noted, and the irregularities for different strengths of the solution were apparently as vagrant as those noted under the amount of liquid absorbed. Figs. 4 and 5 show the expansion or contraction observed when the different woods were immersed in sulphuric acid and caustic soda of varying strengths. With cold solutions all the woods showed temporary expansion. The permanent expansions are not shown in the chart and are considerably more various than the results of the temporary expansion. In general there was less expansion and in some cases contraction. Hot liquids also showed a definite tendency to contract the woods. Still another measurement, that of shrinkage upon drying, was made roughly, and not unnaturally the shrinkage was rather great when the samples were dried after being removed from hot liquids. Cypress and pine were the only woods, upon drying, that did not show contraction in any of the cold solutions. The tendency of certain chemicals to cause swelling or shrinkage is probably best shown by using the figure obtained after the various woods had dried for a week following immersion in either hot or cold liquids. Fig. 6 indicates the effect of the various liquids at room temperature upon the different woods. The permanent expansion or contraction caused by certain hot liquids is shown in Fig. 7. In all cases, however, the various woods showed greater expansion or less contraction, as the case may be, before being dried than after drying.

Physical Condition of the Wood

Perhaps the most interesting set of data is that obtained by studying the physical condition of the strips of wood after removing them from the solution. In general, water solutions of salt, such as calcium chloride, sodium chloride, organic liquids, such as turpentine, linseed oil and the cottonseed oil fatty acids, produced no effect either in hot or cold solutions. Cold calcium hydroxide and cold solutions of sodium bisulphite had no effect. Sulphite of soda in the cold produced no noticeable effect except to soften redwood and had also a slight softening effect on the oak. Neither hot nor cold sodium carbonates had any noticeable action on any of the woods, except oak was somewhat shrunken after being removed from hot solutions. Considerable effect was noticed in the solutions of mineral acids and a table is herewith appended in which these effects have been summarized. Only four kinds of action are recorded in the table for simplicity's sake: Softening, warping or distortion, charring or shredding. A very great number, eighteen in all, were observed, all of them attempting to make some quantitative distinction in the effect noticed. In the table, however, any softening effect is

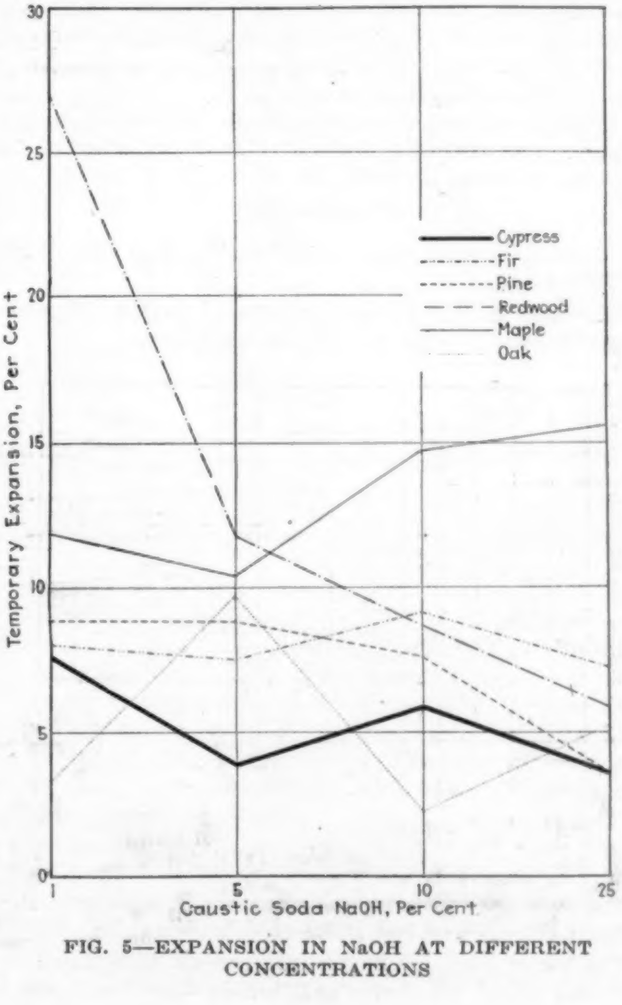


FIG. 5—EXPANSION IN NaOH AT DIFFERENT CONCENTRATIONS

EFFECT OF SOLUTIONS ON THE PHYSICAL NATURE OF WOOD

		Cypress		Fir		Pine		Redwood		Maple		Oak	
		Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot
HCl (Hydrochloric Acid), per cent..	5	....	....	....	S	....	....	W	S, W	....	....	....	.....
	10	....	....	....	S	....	....	W	S, W	....	S	....	.....
	25	....	S, W	....	S, W	....	S	W	S, W	S, W	S, W	W	S, W
	50	S, W	....	S, W	....	....	....	S, W	....	S, W	....	S, W	.....
	conc.	S, W	....	S, W	....	S, W	....	S, W	....	S,W, Ch	....	S, W	....
H_2SO_4 (Sulphuric Acid), per cent....	1	....	S	....	S	....	....	W	S	....	....	....	W
	5	....	S	....	S	....	....	S, W	S, W	....	S	....	....
	10	....	S, W	S	S	....	....	S, W	S, W	W	S	W	....
	25	W	S, W	S, W	S, W	....	S, W	S, W	S,W,Ch.	S, W	S, W	S, W	S, W
HNO_3 (Nitric Acid), per cent.......	5	....	S	....	S	....	S, Shd	S, W	S, W	....	S, Shd	....	S, W, Shd,
	10	....	S, Shd	....	S, Shd	....	S, Shd	S, W	S,W,Shd	W	S, Shd	S,W,Shd	S, W, Shd
	25	S, W	S, Shd	S, W	S, Shd	S, W	S, Shd	S, W	S,W,Shd	S,W,Shd	S, Shd	S,W,Shd	S, W, Shd
NaOH (Sodium Hydroxide), per cent	1	....	....	....	W	....	....	S, W	S	W	W	W	W
	5	....	....	....	W	....	....	S, W	S	W	W	W	W
	10	....	....	W	W	....	W	S, W	S, W	W	W	W	W
	25	....	....	W	W	....	W	S, W	S, W	W	W	W	W

Note: A blank space represents no test.

designated by a capital S. This softening effect may have been very slight or very severe, and it may have taken the direction of pliability, which is also included as a softening effect. There are many different kinds of action represented by the capital W, standing for warping. The strip may have been cracked lengthwise, warped in the usual sense of the word, badly distorted, noticeably shrunken or expanded, but these have all been included in the one term in the table. Charring and shredding are terms which need no further elaboration. In addition it should be noted that some of the woods are rendered distinctly brittle by the action of solutions. For example, hydrochloric acid, 5 per cent, renders redwood very brittle, and much stronger acid has the same effect on maple and oak, but no detrimental effect is noticed on cypress, fir or pine. Sulphuric acid also produces some brittleness in redwood, even at 1 per cent concentration, whereas 5 per cent acid has very little action on any of the other woods. Even 25 per cent sulphuric acid has very slight action on pine, and attacks cypress to only a small extent.

Perhaps we can summarize these qualitative conclusions by some definite statements as to the effect of the various solutions on wood.

Conclusions

Redwood and oak are objectionable from the standpoint of color.

Fir and pine produce pronounced tastes. Cypress imparts neither color or taste to any degree.

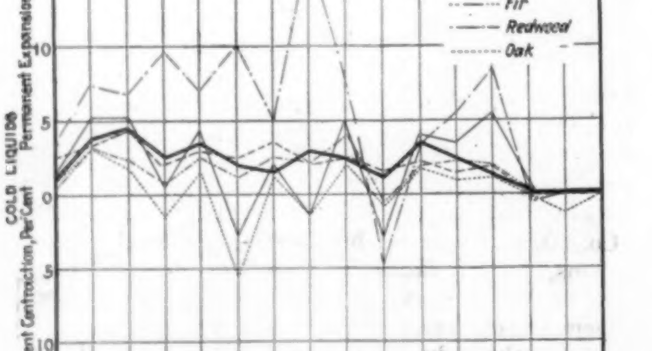


FIG. 6—EXPANSION OR CONTRACTION IN VARIOUS COLD SOLUTIONS

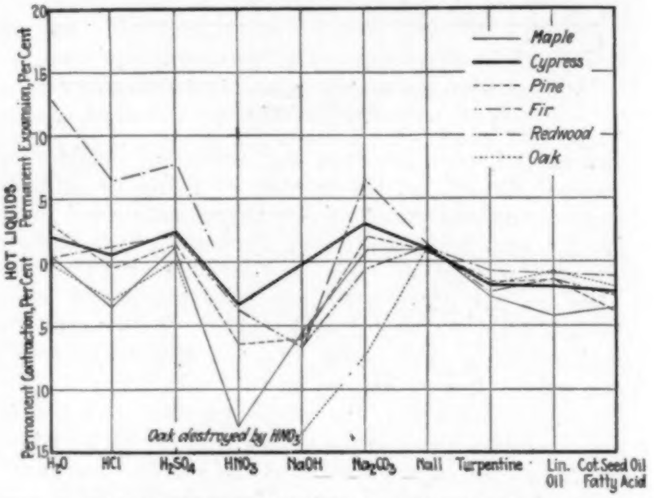


FIG. 7—EXPANSION OR CONTRACTION IN HOT SOLUTIONS

All of the woods absorb the various chemicals to a greater or lesser degree. Oak, maple and redwood have the greatest absorptive powers and fir, cypress and pine the least. Caustic soda and other alkaline solutions are absorbed to the greatest extent, followed by the acid solutions, then the salts and least of all the organic liquids.

Many of the liquids, particularly caustic soda, HCl, HNO_3, bleaching powder and the hot organic liquids, tend to cause shrinkage. This is most pronounced with oak and maple and the least pronounced with cypress and pine.

Nitric acid and caustic soda are the most corrosive of the various liquids tested, then H_2SO_4 followed by HCl and bleaching powder. Most of the other solutions had little or no corrosive action upon the woods.

There is always one wood (and often more) which is able to resist the action of the various chemicals at least in moderate concentrations.

Of the thirty-eight liquids used the number which noticeably affected the different woods at room temperatures (disregarding slight softness and roughening of grain) was as follows: Pine 4, cypress 7, fir 8, maple 13, oak 15 and redwood 22.

Protective Coatings

Waxes or gums, asphalts and coal-tar pitches are sometimes employed as a protective coating upon woods which are to be exposed to the action of corrosive liquids. These products may be either liquids or solids at normal temperatures. The liquids, usually called acidproof paints, are applied with a brush, whereas the solids are melted and then applied. In the latter case,

usually a prime coat of the same or similar material in liquid form is first applied to act as a binder. With those solids which have low melting points or no fixed melting point, as in the case of coal-tar pitch, some substance is frequently mixed with the protective material or else duck or burlap, properly secured to the tank and placed between coatings of the pitch, etc., is used to prevent the material from running down the vertical sides of the tank. Whether these preparations are successful in preventing the penetration of a liquid will depend upon the resistance of the coating to the action of the chemical and upon the completeness with which the pores of the wood are covered. Various coal-tar and asphaltic paints as well as solid materials were tested to determine their resistivity to the various chemical solutions. Melting point determinations were also made on the solid materials.

Most of the samples tested showed great resistivity to the various chemicals used but in the case of strips covered with liquid preparations, absorption took place, expansion or contraction occurred and the other physical manifestations were evident, although much retarded. It would seem that although the material itself was unacted upon, the chemical solution would get through the thin protective film and attack the wood. With the solid materials, especially when the wood was thoroughly and heavily coated, the penetration was very much reduced and thus very much better production was afforded.

From the tank builder's point of view it is desirable to receive information as to the purpose for which the tank is to be used, the chemical and strength of solution to be contained therein, the temperature of the solution and other conditions, as well as the dimensions. He will then be able to determine the proper wood to use, the thickness thereof, the correct metal for hoops or rods—i.e., whether iron, acid-resisting bronze, Monel metal, copper, brass, lead covered, etc.—the proper spacing and sizes of hoops or rods and their protection if necessary; the best method of construction bracing and supports, as well as whether or not linings or protective coatings should be employed.

Function of Magnesium in Fertilizer

Recent investigations by the Bureau of Plant Industry in co-operation with the North Carolina Department of Agriculture have shown that an important leaf disease of tobacco and other plants known to tobacco growers as "sand drown" is due to an insufficient supply of magnesium in the soil or fertilizer. In this disease the green and yellow pigments of the chlorophyll are affected and there is a blanching of the leaf tissues. This blanching invariably begins on the lower, older leaves of the plant and first symptoms usually appear at the tips and outer margins of the leaves.

Corn is affected in much the same way as is tobacco, the leaf blades presenting a striped effect. The disease occurs chiefly on light sandy soils and is more serious in wet seasons, hence the popular name "sand drown." It is an interesting fact that the disease is intensified by increase in the quantity of sulphates in the fertilizer. It has been found that this trouble is prevented by the application of comparatively small quantities of magnesium salts to the soil. The low-grade potash salts which contain magnesium, as well as dolmitic limestones, are effective preventives. Certain organic fertilizing materials such as cottonseed meal, tobacco stems and manure, which contain appreciable quantities of magnesium, tend to prevent the disease.

Coke Industry Recovered in 1922 Despite Difficulties

Byproduct Output Was 28,319,000 Tons—8,007,000 Tons of Beehive Produced—Ovens Consumed 53,311,000 Tons of Coal

By R. S. McBride
Assistant Editor

The year 1922 in the coke industry can well be characterized as one of recovery despite difficulties. The industry has continued to demonstrate that it is a splendid barometer of industrial conditions—perhaps even better than the iron and steel industry, which is commonly so highly regarded as an index of industrial development.

The estimated production of coke during 1922, based upon official returns of the U. S. Geological Survey for 11 months and estimates for December, is 37,326,000 tons, of which 28,319,000 tons was byproduct coke and 8,007,000 tons was from beehive ovens.

Byproduct coke has again outstripped beehive coke and more or less dominates the situation. One should not conclude from these data for the year as a whole, however, that the byproduct branch of the business is really more than three times as large under normal circumstances as the beehive branch, for during the middle of the year the beehive industry suffered more severely through strike conditions, especially in the Connellsville district. This fact is brought out quite clearly by the monthly production figures for the year, which are given in Table I.

Byproduct Ovens End Year Well

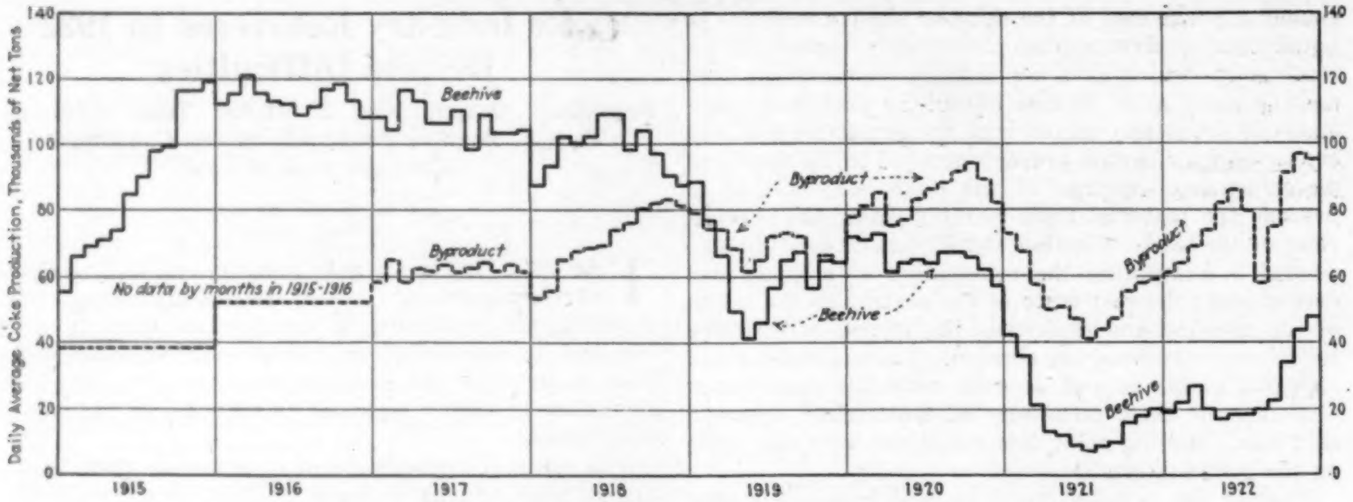
The byproduct coke ovens of the country were operating at approximately 50 per cent of capacity at the beginning of 1922. For the first 6 months of the year the activity of this branch of the business increased steadily, so that in June about 70 per cent activity was estimated by the U. S. Geological Survey. The coal shortage during July and August, however, cut down activities again, production during July being 68 per cent and during August only 49 per cent of the installed-oven capacity. With the resumption of adequate fuel supply in September a prompt renewal of activity ensued, and production during November and December was approximately 80 per cent of the entire installed-oven capacity of the country.

During the year there were regularly from ten to fifteen plants idle. Altogether sixteen plants were idle for a full month or more; but during no single month were more than fourteen of the total number, seventy-one plants, entirely shut down. Seven plants were idle the entire year. No new plants began operation during 1922, but a few ovens were added to some of those already in operation.

New Ovens Constructed

At the beginning of 1922 three plants had new ovens under construction. These were the Woodward Iron Co., thirty ovens; Chicago Byproduct Coke Co., five ovens, and Milwaukee Coke & Gas Co., fifty ovens. All of these were completed during the year and some of them began operation.

The coke industry normally takes about 15 per cent of the bituminous coal produced in the United States. However, in July of 1922 there were used in the coke ovens then active approximately 28 per cent of the entire coal production that month. Of course with normal coal production, no such percentage of the coal would



PRODUCTION OF BEEHIVE AND BYPRODUCT COKE, BY MONTHS, 1915-1922
In the earlier year the older type of ovens produced the more coke, but in 1919 the output of byproduct ovens passed the beehive and is now well in advance

TABLE I—COKE PRODUCTION IN 1922
(In Net Tons)

	Byproduct Coke		Beehive Coke		
	Production	Daily Average	Production	Daily Average	Totals
January	1,879,000	61,000	496,000	19,000	2,375,000
February	1,795,000	64,000	549,000	22,000	2,344,000
March	2,137,000	69,000	732,000	27,000	2,869,000
April	2,208,000	74,000	528,000	20,000	2,736,000
May	2,537,000	82,000	432,000	17,000	2,969,000
June	2,580,000	86,000	458,000	18,000	3,038,000
July	2,486,000	80,000	450,000	18,000	2,936,000
August	1,794,000	58,000	539,000	20,000	2,333,000
September	2,244,000	75,000	606,000	23,000	2,850,000
October	2,806,000	91,000	878,000	34,000	3,684,000
November	2,908,000	97,000	1,139,000	44,000	4,047,000
December (est.)	2,945,000	95,000	1,200,000	48,000	4,145,000
Totals	28,319,000	78,000	8,007,000	26,000	36,326,000

TABLE II—COAL CONSUMED IN COKE PRODUCTION, 1922 (In Net Tons)

	Byproduct Ovens	Beehive Ovens	Total
January	2,699,000	782,000	3,481,000
February	2,579,000	866,000	3,445,000
March	3,071,000	1,155,000	4,226,000
April	3,172,000	833,000	4,005,000
May	3,645,000	681,000	4,326,000
June	3,707,000	772,000	4,429,000
July	3,571,000	710,000	4,281,000
August	2,577,000	850,000	3,427,000
September	3,223,000	956,000	4,179,000
October	4,032,000	1,384,000	5,416,000
November	4,179,000	1,797,000	5,916,000
December (est.)	4,230,000	1,890,000	6,120,000
Total	40,685,000	12,626,000	53,311,000

ever go into coke ovens, but the quantity so used will undoubtedly be large at all times.

In Table II are given figures for the coal consumption in both byproduct and beehive ovens and the total of the two, by months. These figures are those estimated by the U. S. Geological Survey on the assumed basis of 69.6 per cent yield of byproduct coke from coal and 63.4 per cent yield of beehive coke and coal, the average yields for the industry during the preceding calendar year. The December figures are estimates.

At the beginning of 1922 there were in stock at many of the byproduct coke plants several hundred thousand tons of coke for which no market was available. Certainly at no previous time in the history of the industry was there ever on hand anything like this quantity of coke. However, as it became evident during the summer that anthracite would not be available in anything like the usual quantities, purchasers became increasingly interested in the use of coke as a substitute for anthracite. During midsummer the movement of this coke for gas making and for other industrial operations became active and with the early autumn it was an exception to find any unsold coke in stock.

The use of coke as a domestic fuel in place of anthracite has developed more slowly, but inability to get anthracite has compelled attention to this fuel and it is believed that thousands of households are served by coke which have never before used this fuel. This wide market, of course, promises to offer a balance-wheel for the industry which it has never before had. The exact tonnages so employed this year are not known, but it is certain that several times as much coke has been employed for domestic fuel as ever before.

New Constituent Found in High-Speed Steels

Recent work at the Bureau of Standards has discovered an unidentified constituent of relatively great hardness in two samples of high-speed steels. It had previously been found that electrolytic etching with weak solutions of ammonia and with sodium hydroxide has a very similar effect upon the various constituents found so far in alloy steels—namely, both solutions darken chromium carbide and tungsten carbide, while iron carbide and iron tungstide remain unaffected even after etching for several minutes.

The new constituent did not respond to the test for iron carbide and iron tungstide and did not assume any shape usually met with in the case of tungsten carbide. It did respond, however, to the test for chromium carbide—that is, it was darkened by either sodium hydroxide or ammonia. It appeared to be similar in behavior on etching to the very minute particles noted in the matrix of high-speed steel in the condition as received from the mill which were brought out by either ammonia or sodium hydroxide.

Since it would appear from the results of previous investigators that a large part of the chromium present in the high-speed steel is dissolved in the matrix (this would depend on the heat-treatment received), while a large part of the vanadium is present in the free state as carbide, it seemed possible that the constituent referred to above might be a carbide of vanadium. To test this an iron-carbon-vanadium alloy is now being prepared for study wherein it is hoped to have the vanadium and carbon present entirely as vanadium carbide.

Thermal Properties of Aluminum-Silicon Alloys

Accurate Determination of Densities of Aluminum Alloys Containing Variable Amounts of Silicon—Data at Various Temperatures Up to 1,000 Deg. C.—Data on Crystallization Shrinkage, Total Solid Shrinkage and the Tendency to Form Pipe

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A RECRUDESCENCE of interest in the aluminum-silicon alloys has recently been effected by the discovery of methods of preparing them, and particularly of producing what may be called the modified alloys. The history and general properties of these alloys have been described by Jeffries;[1] reference should be made to this article for photomicrographs and descriptions of the structure of the alloys. Suffice it to say that the normal silicon alloys made by melting together silicon and aluminum in the proper proportions, and casting in green sand, exhibit relatively large plates and needles of eutectic silicon. The modified alloys show a very fine dispersion of the silicon and if there is excess aluminum above the eutectic ratio (which ratio varies somewhat with the degree of modification), it may appear as relatively large dendrites. The modified alloy may be produced electrolytically, and by treatment with compounds of the alkali metals with fluorine, as, for example, the method of Pacz.[2]

Another method[3] of producing modified alloys is by the addition of small amounts of metallic sodium or potassium, or both, to the molten alloy before casting. A description of this method by the present writer has already been published in this journal.[4] Modified alloys by this latter method are included in the series of density measurements here reported.

The thermal volume changes of the alloys of aluminum and silicon are believed to be unique among aluminum alloys. The character and magnitude of these changes have been investigated in a series of measurements of the densities of the alloys of aluminum with minor amounts of silicon at temperatures up to about 1,000 deg. C. These measurements have revealed many interesting facts and led to a clearer understanding of the mechanism of solidification of such alloys. Furthermore, they have provided fundamental data necessary for the most intelligent application and manipulation of the aluminum-silicon alloys.

EXPERIMENTAL METHODS

Methods developed in a previous investigation of the density of aluminum have been utilized and further developed in the present investigation. These methods have been described in *Chemical & Metallurgical Engineering*.[5, 6, 7] Density at room temperatures was measured by weighing in water and in air. The values for density are expressed as the mass of the metal in grams per milliliter and of course are comparable with weights *in vacuo*. Weighings made in air with brass weights on an equal arm balance will be about 0.03 per cent less.

Density of the solid alloys was measured at higher temperatures, by weighing in oil (Crisco) at temperatures up to about 250 deg. C. for the lower range and in a mixture of fused salts at the temperatures around 560 deg. C.

Density of the liquid alloy was measured in the densimeter, consisting of a graphite crucible of known volume, centered in a larger container. The whole apparatus is turned from a cylinder of graphite, so that there is an annular space surrounding the inner crucible which may be filled with a suitable molten metal to aid in producing a uniform temperature in the inner crucible which it surrounds. The crucible of known volume is completely filled with the molten metal at a temperature lower than that at which its density is to be measured. The cover is then screwed on tightly and the crucible raised to the desired temperature, by increasing the temperature of the electric furnace in which the apparatus is placed. The temperature is ascertained by means of a thermocouple placed in the metal bath in the annular ring. As the alloy within the crucible is heated, it expands and fills the known volume exactly; the excess metal runs out through two very small channels formed by the cover and two small grooves in the top face of the inner crucible.

When the desired temperature has been reached and maintained for a sufficient period to insure uniformity, any beads of metal extruded from the inner crucible are detached, the bath metal poured out, and the metal in the inner crucible allowed to solidify. When solid it can be removed and weighed. The volume of the crucible is determined at room temperature by filling with mercury and weighing the mercury. Its volume at the temperature of measurement is calculated from the known expansivity of graphite. From the weight and volume, the density of the alloy is readily calculated.

DENSITY OF AL-SI ALLOYS AT 20 DEG. C.

In Fig. 1 are plotted the results of density measurements on silicon alloys, normal and modified, containing from 0.5 to 18 per cent silicon, and cast in graphite and in sand. There is also included one sample of hard rolled sheet. Table I contains a selection of the numerical results, giving the chemical composition. The samples cast in graphite were cylindrical, and 1 in. in diameter.

The measurements were made at the prevailing room temperatures and all measurements have been corrected to the density at a uniform temperature at 20 deg. C. This correction was always less than 0.1 per cent of the density, so that it was sufficiently accurate to use an average expansion coefficient of 0.000022 per degree C. in calculating this correction.

The samples which were modified by the addition of alkali metal, were treated with approximately 0.05 per cent metallic sodium plus 0.05 per cent metallic potassium just prior to casting. The structure of typical normal and modified alloys is illustrated in references 1 and 4.

In alloy systems where there are no compounds formed, it is usually found that the specific volumes (the reciprocals of the densities) of the alloys will be very nearly a linear function of their composition.

[1] "Aluminum-Silicon Alloys," by Zay Jeffries, *Chem. & Met.*, vol. 26, pp. 750-754 (1922).

[2] U. S. Pat. 1,387,900, Aug. 16, 1921.

[3] Edwards, Churchill and Frary, U. S. Pat. 1,410,461, March 21, 1922.

[4] "Aluminum-Silicon Alloys," by Junius D. Edwards, *Chem. & Met.*, vol. 27, p. 654 (1922).

[5] "Density of Aluminum From 20 Deg. to 1,000 Deg. C.," by Edwards and Moorman, *Chem. & Met.*, vol. 24, pp. 61-64 (1921).

[6] "Mechanism of Solidification of a Copper-Aluminum Alloy," by Edwards, *Chem. & Met.*, vol. 24, pp. 217-220 (1921).

[7] "Causes of Piping in Aluminum Ingots," by Edwards and Gammon, *Chem. & Met.*, vol. 24, pp. 338-340 (1921).

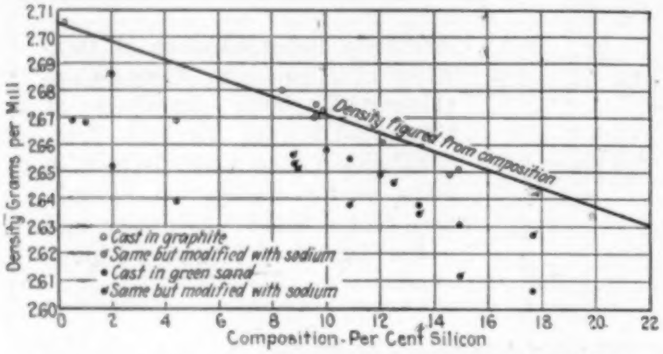

FIG. 1—DENSITY OF ALUMINUM-SILICON ALLOYS AT 20 DEG. C.

According to Richards,[1] the density of silicon at 20 deg. C. is 2.42. The density of aluminum of the purity used in making these alloys is about 2.705.

The density curve of the alloys, calculated on the basis of such a linear relation between the specific volumes, is represented by the solid line in Fig. 1. The specimens cast in graphite, and having presumably the lowest porosity, are closely grouped along this graph. The densities of the sand-cast specimens containing approximately 2 and 4 per cent silicon were very much lower than this curve, and even after remelting and casting in graphite were still below the curve. The question arises as to whether the large variations in density observed with alloys of practically the same composition are caused by structural changes or are merely the result of variations in porosity. The density of the samples modified by the addition of a very small amount of alkali metal is slightly lowered. However, the lowest densities are not characteristic of the greatest grain refinement. The lowest densities are observed in the sand-cast specimens, whereas the greatest grain refinement is secured in the modified alloys chill cast. This would seem to indicate large variations in "porosity" of some kind. However, practical experience has demonstrated that aluminum-silicon alloys are unusual in their lack of permeability to liquids so that pore spaces if present must be isolated and small.

Frilley[2] has recorded a series of measurements on the density of the aluminum-silicon alloys. His data on the 10 and 20 per cent silicon alloys are about 5 per cent lower than the values given in the present paper. The reasons for these low results are not apparent.

Density of Solid Aluminum-Silicon Alloys at Higher Temperatures

In order to complete the density curves up to the melting point, the densities of two representative normal alloys were determined at temperatures of 200 deg. C. and 563 deg. C. These determinations also permitted an approximate calculation of the expansivity. Density at the lower temperature was determined by weighing the sample in air and when immersed in Crisco at a temperature of 200 deg. C. The density of the Crisco was determined at the same time as the weighing of the alloy by means of a platinum cylinder whose volume was accurately known.

A slow change in composition of the Crisco at this temperature made it difficult to secure an accuracy greater than 0.2 per cent. A new sample of Crisco was used for each series of measurements, and its density was checked by repeated weighings of the platinum cylinder.

Weighings at 563 deg. C. were made in a fused mixture of lithium and potassium sulphates. According to Nacken, quoted in Landolt-Börnstein Tabellen, there is a eutectic mixture of these two salts which freezes at 535 deg. C. and contains 20 mol per cent of potassium sulphate. I used a mixture containing about 25 weight per cent of potassium sulphate, and found it quite satisfactory, although the freezing point of the salt (about 540 deg. C.) and the melting point of the aluminum-silicon eutectic (577 deg. C.) gave only a very small temperature range to work in, and made the measurements tedious and difficult.

Density of Liquid Aluminum-Silicon Alloys

The graphite densimeter was used for determining the density of the liquid alloys. The density of relatively pure aluminum is known from the previous measurements referred to, and the effect of the addition of 8 and 12 per cent silicon was observed in the present series. Results are given in Table III.

These alloys were all normal alloys. The modified alloys, strictly speaking, exist only in the solid state, because the modification is a structural change taking place during the crystallization of the liquid. A liquid alloy with alkali metal added has only the potential property of becoming a modified alloy.

A graph of these results indicates the expansion of the liquid alloy to be practically linear from the melting point to at least 1,000 deg. C., and the greatest deviation from a straight line fitted to the data is less than 0.1 per cent. In Table IV are given convenient values for these alloys as taken from the plotted graphs. Fig. 2 shows the freezing points of the aluminum-silicon

[1] *J. Am. Chem. Soc.*, vol. 37, p. 1646 (1915).
[2] *Revue Métallurgie*, vol. 8, p. 457 (1911).

TABLE I—DENSITY OF ALUMINUM-SILICON ALLOYS

Composition, Per Cent Si	Fe	Cu	Treatment	Density at 20 Deg. C.	Condition of Specimen
0.52	0.24	....	Normal	2.669	Sand-cast bars, ½ in. sq.
2.01	0.30	....	Normal	2.652	Sand-cast bars, ½ in. sq
2.01	0.30	....	Normal	2.686	Recast in graphite
4.38	0.44	....	Normal	2.639	Sand-cast bar, ½ in. sq
4.38	0.44	....	Normal	2.669	Recast in graphite
8.37	0.42	....	Normal	2.680	Cast in graphite
8.83	0.41	0.26	Modified	2.653	Sand-cast test bar
9.61	0.43	....	Normal	2.675	Cast in graphite
9.79	0.43	0.04	Modified	2.654	Hard-rolled—14 gage
9.92	0.36	0.06	Normal	2.673	Cast in graphite
10.88	0.39	0.03	Normal	2.655	Sand-cast test bar
10.88	0.39	0.03	Modified	2.638	Sand-cast test bar
12.07	0.47	....	Normal	2.661	Cast in graphite
13.40	0.42	0.04	Normal	2.638	Sand-cast test bar
14.88	0.54	0.02	Normal	2.651	Cast in graphite
14.95	0.55	0.03	Normal	2.631	Sand-cast test bar
17.66	0.52	0.04	Modified	2.627	Sand-cast test bar

TABLE II—DENSITY OF NORMAL ALUMINUM-SILICON ALLOYS AT 200 DEG. C. AND 563 DEG. C.

Composition					Density (Grams per Milliter)		
Si Per Cent	Fe Per Cent	Cu Per Cent	Mn Per Cent	Al Per Cent	20 Deg. C.	200 Deg. C.	563 Deg. C.
7.81	0.39	0.12	nil	91.68	2.678	.....	2.570
7.81	0.39	0.12	nil	91.68	2.680	2.647	.....
7.81	0.39	0.12	nil	91.68	2.680	2.640	.....
11.63	0.45	0.11	nil	87.81	2.661	.....	2.560
11.63	0.45	0.11	nil	87.81	2.663	2.635	.....
11.63	0.45	0.11	nil	87.81	2.663	2.626	.....
0.11	0.13	0.008	nil	99.752	2.689	2.653	.....

TABLE III—DENSITY OF LIQUID ALUMINUM-SILICON ALLOYS

Composition					
Si Per Cent	Fe Per Cent	Cu Per Cent	Al Per Cent	Temperature Deg. C.	Density g./ml.
7.81	0.39	0.12	91.68	663	2.413
7.81	0.39	0.12	91.68	802	2.375
7.81	0.39	0.12	91.68	904	2.345
11.63	0.45	0.11	87.81	643	2.441
11.63	0.45	0.11	87.81	801	2.392
11.63	0.45	0.11	87.81	904	2.356

TABLE IV—DENSITY OF ALUMINUM-SILICON ALLOYS

Temperature	Condition of Metal	Density: Silicon 0.2 Per Cent	Density: Silicon 7.81 Per Cent	Density: Silicon 11.63 Per Cent
Centigrade Temperature Scale				
20	Solid	2.706	2.679	2.662
200	Solid	.....	2.644	2.630
600	Liquid	.....	.....	2.456
700	Liquid	2.373	2.404	2.423
800	Liquid	2.345	2.375	2.391
900	Liquid	2.318	2.346	2.358
1000	Liquid	2.291	2.317	2.326
Fahrenheit Temperature Scale				
68	Solid	2.706	2.679	2.662
1300	Liquid	2.371	2.402	2.422
1400	Liquid	2.356	2.386	2.404
1500	Liquid	2.341	2.370	2.386
1600	Liquid	2.326	2.354	2.368
1700	Liquid	2.311	2.338	2.350
1800	Liquid	2.296	2.322	2.332
1900	Liquid	2.280	2.306	2.314
2000	Liquid	2.265	2.290	2.296

alloys containing from 0 to 15 per cent silicon, and Fig. 3 a series of isotherms giving the densities of these alloys at 700, 800, 900 and 1,000 deg. C.

The normal eutectic composition is usually given as about 10 per cent silicon. Fraenkel[10] reported 10 per cent and a eutectic temperature of about 576 deg. C. Roberts[11] reported 10 per cent and 578 deg. C.

Observations made in the course of the present work indicated a normal eutectic temperature of approximately 577 deg. C. and a eutectic composition between 11 and 12 per cent, or more exactly, 11.6 per cent of

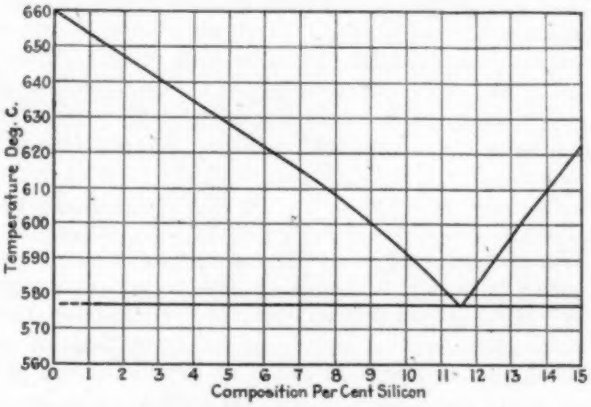

FIG. 2—EQUILIBRIUM DIAGRAM, Al-Si ALLOYS

silicon. As previously noted[4] the presence of a modifying agent will change the eutectic composition and temperature in a very significant manner.

Thermal Expansivity of Aluminum-Silicon Alloys

Data on the thermal expansivity of aluminum are quite well known, but there are only a few measurements available on silicon, and they are at temperatures below 100 deg. C. For comparison, two of these values are given in Table V.

TABLE V—THERMAL EXPANSIVITIES OF ALUMINUM AND SILICON

Metal	Temperature Deg. C.	Expansivity $\frac{\Delta l}{l_0}$	Authority
Aluminum	40	0.0000229	Bureau of Standards (1921)
Silicon	40	0.0000076	Fizeau (1869)

There may be some question as to the purity of the silicon tested by Fizeau, but the data as they stand indicate that silicon has only about one-third the ex-

[10] *Z. anorg. Chem.*, vol. 58, p. 154 (1908).
[11] *J. Chem. Soc.*, vol. 105, p. 1,383 (1914).

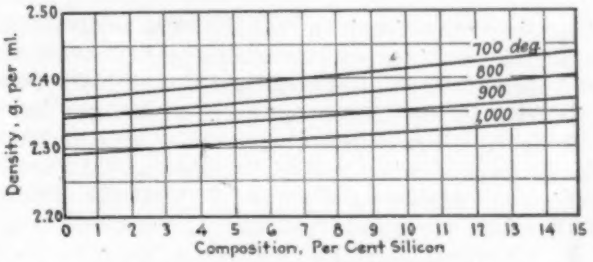

FIG. 3—DENSITY OF ALUMINUM-SILICON ALLOYS AT ELEVATED TEMPERATURES

pansivity of aluminum. This fact is reflected in the expansivities of the aluminum-silicon alloys. The average linear expansion coefficient of the sample of relatively pure aluminum quoted in Table II, between 20 and 200 deg. C., is calculated as 24.8×10^{-6}. This value agrees with that calculated from the expansion formula published by the Bureau of Standards—namely 24.8×10^{-6}. The expansivity of the eutectic alloy (11.63 per cent silicon) as calculated from the density measurements at 20 and 200 deg. C. is 22.2×10^{-6}, which is about 10 per cent less than the expansivity of aluminum. No great confidence can be placed in this value unless supported by other evidence, as a small error in the density measurements—say 0.1 per cent, for example—would make a difference of about 8 per cent in the expansivity. However, other unpublished information makes it appear that this value is correct to within 3 per cent.

The average expansion coefficient of the eutectic alloy between 20 and 577 deg. C., as determined from measurements of total solid shrinkage, is approximately 23.5×10^{-6}, while that of aluminum over the same range is about 29×10^{-6}. It seems demonstrated, therefore, that the linear expansion of the aluminum-silicon alloys is appreciably less than that of aluminum.

Solid and Crystallization Shrinkage of Aluminum-Silicon Alloys

The solid shrinkage and crystallization shrinkage are important factors in determining the casting qualities of an alloy. The crystallization shrinkage is the percentage change in volume in changing from a liquid at the freezing point to a solid at the melting point. In Fig. 4 are shown the complete density curves for pure aluminum (99.75 per cent aluminum) and the 7.81 and 11.63 per cent silicon alloys. The construction of such curves was described in detail in the article on the freezing phenomena of the copper-aluminum alloys.

The most striking characteristic of these curves is that, although the solid aluminum-silicon alloys are

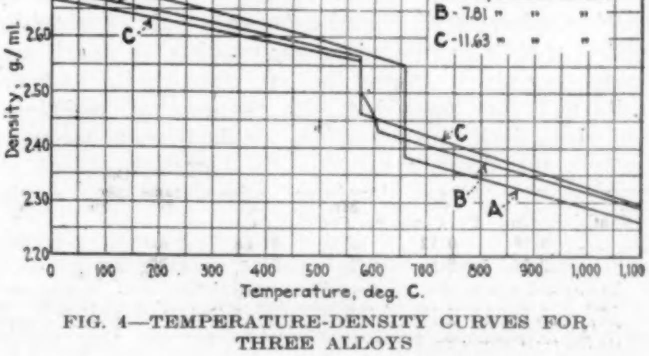

FIG. 4—TEMPERATURE-DENSITY CURVES FOR THREE ALLOYS

lighter than pure aluminum (at the same temperature), the liquid aluminum-silicon alloys are heavier than liquid aluminum. The obvious and undoubtedly correct explanation is that silicon contracts on melting and expands on freezing. Zimmerman[12] states that silicon appears to expand when solidifying, but no data bearing on this point have been discovered. That the silicon in the alloy does expand on freezing is a fortunate circumstance for the industrial application of these alloys, because it materially reduces the crystallization shrinkage. Whereas the crystallization shrinkage of 99.75 Al is 6.6 per cent, that in the alloy containing 7.81 per cent Si is 5.6, and 11.63 per cent Si is as low as 3.8 per cent.

Crystallization shrinkage thus decreases with increasing amounts of silicon. A few measurements were made on an alloy containing 22.4 per cent silicon, to determine its shrinkage properties. Insufficient data were obtained to make the results more than a good approximation, but indicated a crystallization shrinkage of about 1.6 per cent.

In this connection, attention should be called to the fact that the densities of the solid alloys in Fig. 4 correspond to the most dense condition characteristic of chill-cast alloys, and are represented by the solid line of Fig. 1. In sand-cast alloys and alloys treated with a dispersing agent, the density of the solid will be appreciably less, and the shrinkage correspondingly smaller. The values noted above represent, therefore, the maximum values for the crystallization shrinkage.

TABLE VI—TOTAL SOLID SHRINKAGE (577 DEG. TO 20 DEG. C.)

Sample No.	Composition	Total Solid Shrinkage (In. per Ft.)
....	Aluminum (99.75 per cent Al) (658-20 deg.)	0.21
1593	Si, 12.55; Fe 0.56; Cu 0.8; Al 86.81	.16
1594	Same as 1593 + 0.04 Na + 0.04 K at 1470 deg. C.	.15
256	Si, 22.4; Fe 0.70	.15

In practice, they will probably be smaller. For example, the density at 20 deg. C. of the eutectic alloy was observed to be 2.662, whereas Fig. 1 indicates that if it had been modified with alkali metal and sand cast, its apparent density might have been about 2.635, whereupon the crystallization shrinkage would have been only about 3 per cent instead of 3.8 per cent. Estimates obtained by extrapolation of our density curves indicate that a 30 per cent silicon alloy would have a crystallization shrinkage of less than 1 per cent in the modified condition.[13] Observations of the cooling of ingots of a 50 per cent silicon alloy made in another connection indicated an expansion instead of shrinkage during crystallization. The surface of the ingot froze in rounded form, and as the last of the eutectic solidified, it was extruded from the center of the ingot in the form of a globule of metal.

The total solid shrinkage of a number of alloys is given in Table VI. These values were determined by casting a bar of the metal between a pair of graphite plates, rigidly maintained a known distance apart, and measuring the length of the bar when cold. Such results will vary somewhat with the casting conditions, but give a good approximation. In the foundry the same pattern shrinkage is used for the aluminum-silicon alloys as for other aluminum alloys—namely, $\frac{5}{32}$ in. (0.156 in.).

[12] *Trans.*, Am. Electrochem. Soc., vol. 15, p. 396 (1909).

[13] Physical properties of the alloys containing over 20 per cent silicon are not such as to indicate any but very special uses for them. The 22 per cent alloy, sand cast, showed a tensile strength of 7,200 lb. per sq.in., an elongation of 0.5 per cent, and a Brinell hardness number of 59.0.

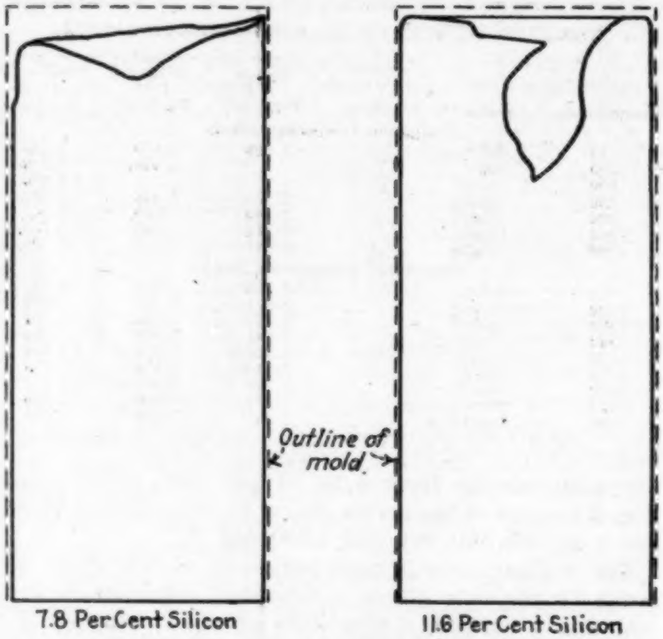

FIG. 5—CHARACTER OF PIPING IN CYLINDRICAL INGOTS OF ALUMINUM-SILICON ALLOYS

Comparison of Aluminum-Silicon Alloy With 8 Per Cent Aluminum-Copper Alloy

It is of interest to compare certain properties of the aluminum-silicon alloys with those of the 8 per cent aluminum-copper alloy, because they may compete in some fields. For the purpose of comparison, we shall consider in Table VII only the eutectic alloy which contains about 11.6 per cent silicon. In practice alloys containing from 5 to 13 per cent silicon will be used, but conclusions drawn from the properties of the eutectic alloy will hold in general for the other alloys.

The casting qualities of the silicon alloy are in some respects superior to those of the 8 per cent copper alloy. This should follow from the fact that its crystallization shrinkage is only half as great and its total solid shrinkage about 15 per cent less than that of the aluminum-copper alloy. Our data indicate that its thermal expansivity is also appreciably lower than that of the aluminum-copper alloy.

TABLE VII—COMPARISON OF 11.6 PER CENT SILICON ALLOY WITH 8 PER CENT COPPER ALLOY

Property	Eutectic Aluminum-Silicon Alloy	8 Per Cent Aluminum-Copper Alloy
Freezing range (deg. C.)	577	636 to 540
Proportion of eutectic (per cent)	100	14
Crystallization shrinkage (per cent)	3.8	6.7
Total solid shrinkage (in. per ft.)	0.15 to 0.16	0.18
Density at 20 deg. C. (grams per milliliter)	2.66	2.86
Density of liquid at freezing point (grams per milliliter)	2.46	2.545

The conclusions regarding piping in aluminum alloys reported in an article in *Chemical & Metallurgical Engineering* (vol. 24, p. 338, 1921) are further confirmed by observations on the aluminum-silicon alloys. In aluminum-copper alloys it was found that increase of copper content beyond a certain limit did not cause any further decrease in the piping effect, and that the eutectic alloy (31 per cent copper), which freezes at constant temperature produced a greater pipe than the 8 per cent alloy, which freezes over a temperature range of 636 to 540 deg. C. This we ascribed to the greater plasticity of the mixture of solid and liquid metal when

it freezes over a considerable range of temperature. Examination of ingots cast from 7.8 and 11.6 per cent silicon alloys showed that the 7.8 per cent alloy, which has a freezing range of 608 to 577 deg. C., showed the rounded edges and small piped cavity characteristic of the 8 per cent aluminum-copper alloy. The eutectic silicon alloy, however, had a more pronounced pipe than the 7.8 per cent alloy, even though its crystallization shrinkage was less. This difference in appearance is illustrated by Fig. 5. A 10 per cent silicon alloy might therefore be expected to have somewhat better casting qualities than a 12 per cent alloy.

The liability to segregation will probably be lower in the silicon alloys than in the copper alloy, because the densities of solid and liquid during freezing are very much closer together than in the case of the copper alloy. Some estimates on the 8 per cent silicon alloy showed that the densities of solid and liquid in equilibrium during freezing never differed by more than 5 per cent.

Ethylene Glycol: Its Uses and Properties

Some Interesting Fields of Usefulness for a Distinctly New and Unusual Solvent, Reagent and Preservative

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It is a point of interest that the organic chemical compounds which have had the greatest individual value to the chemical industries, as well as to the public at large, have been those classified chemically as members of the alcohol series. In particular ethyl alcohol, in its legitimate uses, and glycerine have found countless applications and are almost indispensable to the requirements of everyday life. To the rather limited number of such commonly available compounds there has been added, through recent commercial developments, the substance ethylene glycol, a solvent, reagent and preservative of unusual properties.

Ethylene glycol is a pure chemical substance, corresponding to the formula $C_2H_4(OH)_2$. It is a dihydric alcohol, of composition intermediate between that of glycerine and ethyl alcohol, and possesses valuable properties of both these important chemicals, as well as characteristic properties of its own. The pure ethylene glycol on the market is a water-white liquid (sp.gr., 1.116), without odor, possessing a pleasantly sweet taste. It is non-volatile (b.p., 198 deg. C.) at ordinary temperatures, and on exposure to the air it does not evaporate, but attracts moisture, thus giving it valuable moistening properties. It has a low freezing point, and furthermore serves well to lower the freezing point of water solutions; in moderate concentrations, it prevents freezing below the coldest winter temperatures.

As a solvent, ethylene glycol has many of the characteristics of ethyl alcohol and is an efficient solvent for many classes of compounds, such as esters, medicaments, resins, flavors and dyes. It is, of course, miscible with water in all proportions and also with ethyl alcohol and many other organic solvents. It has none of the intoxicating properties of ethyl alcohol; indeed, it appears to be quite harmless when taken internally, even in large amounts.

In view of the large uses for ethylene glycol which are possible in the foodstuff and pharmaceutical fields, research has been carried out to establish definitely its physiological action[1] as well as the bactericidal effects expected from its similarity to ethyl alcohol. Ethylene glycol has been demonstrated to be innocuous on the animal economy. Doses of considerable magnitude, continued for many weeks, produced no outward manifestation on test animals (rabbits). On autopsy, these animals showed no abnormal reactions or changes. From the results obtained it is apparent that this substance can be used without apprehension in the compounding of products for internal consumption.

In tests run in parallel with ethyl alcohol and glycerine, ethylene glycol has been shown to have marked preservative properties against standard cultures of bacteria. Ethylene glycol showed some inhibition at a 10 per cent concentration and was completely disinfectant at 20 per cent concentration. In these tests ethylene glycol showed a close approach to the bactericidal power of ethyl alcohol and to double that of glycerine.

In a commercial sense, ethylene glycol is so new to the chemical industries that the full number of its uses has not been standardized. New applications are being made continuously with good success, showing that in time it will take its place as a standard material in the same industrial class with ethyl alcohol and glycerine, not as a substitute, but as a pure material with irreplaceable properties of its own.

Uses in Foods and Medicines

Ethylene gylcol is a high-grade solvent and preservative for use in the manufacture of concentrated fruit flavors, fountain supplies and flavoring extracts. It also has much to recommend it as an ingredient in the compounding of food pastes, canned goods, ketchups, mincemeats, salad dressings and other commodities of like consistency. Flavoring extracts with glycol as the vehicle are considerably brighter in appearance, with less tendency toward turbidity, than similar products in which glycerine is used.

In the drug and medicine field ethylene glycol will be found to be a valuable solvent and preservative in liquid products wherein it is the desire to reduce or entirely eliminate ethyl alcohol. Its properties make it a much more desirable substance than glycerine, the preservative action of which is not uniform. Being much less viscous than glycerine, ethylene glycol alters but slightly the original character and consistency of the product, which thus retains the same appearance as when ethyl alcohol is used as the solvent and preservative. In many cases, too, the lower volatility of ethylene glycol makes it preferable to ethyl alcohol in compounding preparations which are apt to suffer from drying out due to loss of the alcohol. Toilet preparations and cosmetics which have combined antiseptic and emollient properties, such as facial creams, may also use glycol with success.

Useful Moistening and Anti-Freezing Properties

The combined preservative and moistening characteristics of ethylene glycol recommend it for a wide number of uses, including the manufacture of many cosmetics, the preparation of anatomical and biological specimens, the treatment of skins and furs by the taxidermist, the moistening of tobacco and similar instances where a non-volatile material free from

[1]The discussion of the physiological action of ethylene glycol in this paper has been taken from a private communication from H. C. Fuller, which will be published in full detail at a later date.

injurious action or unpleasant taste or odor is required. For moistening smoking tobacco, especially, ethylene glycol possesses a distinct advantage in that no sharp, disagreeable products are formed upon burning, as is the case with a number of the moistening agents now used.

To the textile and leather industries ethylene glycol offers possibilities as an aid in the finishing and dyeing of fabrics and as a means of preserving the suppleness and flexibility of leather during processing.

The advantageous freezing point depression which ethylene glycol shows in water solution again makes it valuable for use in preparation of extracts, medicines and toilet preparations and for industrial purposes such as lowering the freezing point of cooling water in automobiles and airplane radiators, exposed dashpots, gages, etc. In this latter connection, glycol solutions of different concentrations have been found to remain fluid at the following temperatures:

Concentration, Per Cent of Ethylene Glycol	Safe Limit of Use, Deg. F.
10	+14
15	+5
22	—5
30	—22
40	—38

As in the cases where denatured alcohol, glycerine or other anti-freezing mixtures are used, water solutions of ethylene glycol freeze over a range of several degrees as the temperature drops. Complete solidification, which results in damage to the radiator or water jacket, does not occur until a temperature considerably lower than that given in the above table is reached. Anti-freezing mixtures composed of ethylene glycol are not so volatile as alcohol solutions and do not lose their concentration through evaporation, nor do they possess the disagreeable odor characteristic of some denatured alcohol used today. As compared with glycerine or glucose, there is a much greater freezing-point depression per weight of glycol used, and less tendency to become gummy or to caramelize. Because ethylene glycol is not an electrolyte and is perfectly neutral, there is no corrosion of any parts, even where copper, brass or aluminum are in contact with iron or with one another. Then, too, in effective concentration there is no action on rubber connections.

Ethylene glycol, on account of its low freezing point and lubricating properties, may also be used in gas meters and ice machines and where the use of a petroleum oil lubricant is undesirable.

Possibilities as a Reagent and Raw Material

As a technical reagent ethylene glycol has already found valuable application abroad in the preparation of explosives. Ethylene glycol dinitrate is in some ways superior to nitroglycerine in the manufacture of dynamite, being less sensitive to shock, having greater force in explosion, and, what is most important, constituting a necessary part of a dynamite, not subject to freezing, even in the coldest weather.

Another glycol derivative, glycol diacetate, has been found to be a cellulose ester solvent, comparable with the widely used amyl and butyl acetates. It has the great advantage that it is practically odorless; furthermore, it has a higher boiling point (186 deg. C.), which permits the same effect with less material in prepared cellulose solutions. The solvent properties of glycol diacetate toward organic compounds and dyes suggest also applications similar to those of the glyceryl acetates which are used so frequently in the printing and dyeing of cotton and as solvents in the coloring of pyroxylin plastics.

The commercial production of ethylene glycol comes at a time when the American chemical industry is asserting itself strongly in world competition after the removal of the direct effects of the war. In Europe ethylene glycol is already finding ever-increasing fields of usefulness. Consequently an American source of this material will no doubt be of value to many of our industries and will assist in keeping them in the forefront.

New York City.

Manufacture of Varnishes in 1921

Reports made to the Bureau of the Census show a decrease in the volume of business done by the establishments engaged primarily in the manufacture of varnishes, japans and lacquers during the year 1921 as compared with 1919. The total value of products reported for 1921 amounted to $71,239,000, compared with $83,632,000 for 1919, a decrease of 14.8 per cent. Of the 222 establishments reported for 1921, 43 were located in New York, 35 in Illinois, 30 in New Jersey, 28 in Ohio, 17 in Pennsylvania, 12 in Missouri, 11 in Massachusetts, 8 each in Indiana and Michigan, 6 in California, 5 in Kentucky, 4 in Connecticut, 3 each in Maryland and Minnesota, 2 each in Maine, Oregon, Rhode Island and Virginia and 1 in Wisconsin.

The decrease in the value of products has been accompanied by decreases in the cost of materials used, and in the amount paid to salaried employees; but the returns show an increase in the average number of wage earners employed and in the amount of wages paid. In May, the month of maximum employment, 4,396 wage earners were reported; and in February, the month of minimum employment, 3,954—the minimum representing 89.9 per cent of the maximum. The average number of wage earners employed during the year was 4,138 as compared with 4,022 in 1919. A classification of the wage earners with reference to the prevailing hours of labor in the establishments in which employed shows that for 2,411, or 58.3 per cent of the total (average) number, the hours per week were between 48 and 54; for 618, or 14.9 per cent, they were 48 per week; and for 777, or 18.8 per cent, they were less than 48 per week; only 332, or 8 per cent, were reported by establishments in which the prevailing hours of labor per week were 54 or more.

The statistics for 1921 and 1919 are summarized in the following statement; the figures for 1921 are preliminary and subject to such change and correction as may be found necessary from a further examination of the original reports.

	1921*	1919*	Per Cent of Decrease†
Number of establishments	222	229	......
Persons engaged	6,962	7,385	5.7
Proprietors and firm members	54	72	......
Salaried employees	2,770	3,291	1.58
Wages earners (average number)	4,138	4,022	§2.9
Salaries and wages	$12,888,000	$12,821,000	§0.5
Salaries	7,027,000	8,253,000	14.9
Wages	5,861,000	4,568,000	28.3
Paid for contract work	4,400	39,900	89.0
Cost of materials	44,084,000	51,508,000	14.4
Value of products	71,239,000	83,632,000	14.8
Value added by manufacture‡	27,155,000	32,124,000	15.5

* Figures for 1921 do not include establishments reporting products under $5,000 in value, thus excluding 10 establishments which employed 84 wage earners, and in the aggregate reported products to the value of $31,060. The figures for 1919, however, include 9 such establishments, which employed 6 wage earners, and reported products to the value of $20,035.

† Percentages omitted where base is less than 100.

‡ Value of products less cost of materials.

§ Denotes increase.

The Low-Temperature Carbonization of Coal

IV—Improved Type of Primary Retort for Low-Temperature Carbonization and Results Obtained Therewith

By Harry A. Curtis and Walter J. Geldard

IN ONE of the previous papers[1] of this series the authors described the various commercial-size retorts for low-temperature carbonization which were built and tested at Irvington, N. J., up to the time when the Clinchfield plant was put into operation. The development work at Irvington was continued, however, for a little more than a year after the Clinchfield plant was started. During this time the most noteworthy large-scale development at Irvington consisted in the construction and testing of a modification of the Clinchfield type of retort. This latest retort, known in the company's records as Retort No. 25, is shown in Figs. 1 and 2. It differed in a number of ways from the Clinchfield type, the most important modifications being as follows:

a. A readily removable cast-iron top on the retort in place of the complete carborundum muffle used at Clinchfield.

b. A regenerative type of heating in place of the recuperative type.

c. The discharge screws placed just below level of retort floor at discharge end instead of at bottom of a vertical chute several feet long.

d. Provisions for greater agitation of the coal during carbonization, through increasing the number of paddles per shaft and through increasing the speed of rotation of the shafts.

Aside from these major differences there were many minor ones, such as gearing the two paddle shafts together; provisions for wider variations in speed oi paddle shafts; two pairs of discharge screws in place of one pair, etc.

Retort No. 25 was designed by C. V. McIntyre with, of course, the co-operation of various other members of the company's technical staff. While later experience at Clinchfield has pointed out ways in which to improve Retort No. 25, this retort, nevertheless, represented a very distinct advance in the art of low-temperature carbonization.

Coal Feed

Coal to be carbonized was crushed to pass a $\frac{3}{4}$-in. screen, weighed, put through a drier and delivered as required to a feed screw hopper. Coal was fed to the retort by a 9-in. screw operated intermittently, the rate of feed being controlled by an electric "flasher" for varying the "on" and "off" periods of the screw. This method of feed control proved far inferior to the Clinchfield type, where the screws are run continuously, their speed being controlled by gear changes.

Agitation of Coal in Retort

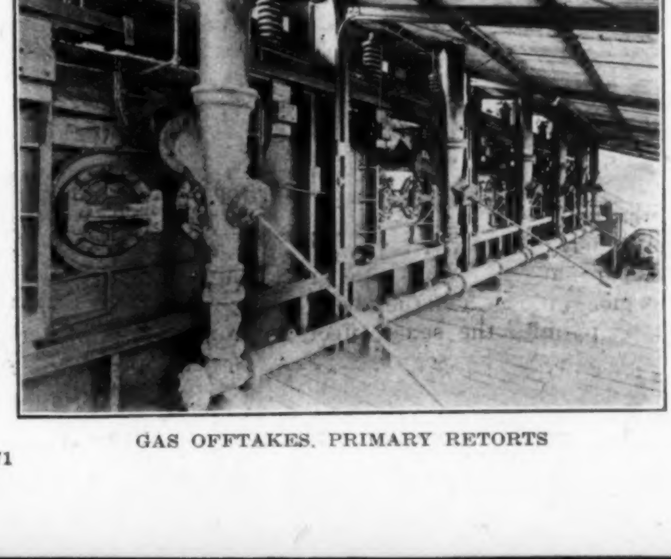
The two paddle shafts were made of steel pipe with the paddles held in place by two bolts per pair of paddles. Provision was made for eighty paddles per shaft, more than twice the number used in the Clinchfield retorts. The paddle shafts carried 34-in. gears at the feed end of the retort, these gears meshing with each other, the left-hand gear being driven by a pinion. A train of gear changes on the pinion drive permitted rotation of paddle shafts at various speeds between 0.43 r.p.m. minimum and 19.55 r.p.m. maximum. A 25-hp. motor was used to drive the paddle shafts.

While there was wider range of possible paddle speeds, the whole mechanism for agitating the coal in Retort No. 25 must be considered as mechanically inferior to the corresponding Clinchfield machinery. The idea of using steel or wrought-iron pipe for paddle shafts is probably a good one, since it is very much cheaper than the cast-steel paddle shafts used at Clinchfield. In Retort No. 25, however, the bearings were poor and it was very difficult to get at the stuffing boxes behind the large gears. It would probably be better to put steel gudgeons in the ends of the pipe and carry the shafts on heavy bearings a foot or so away from the retort end castings. The end thrust on the paddle shafts should be taken care of at the feed end of the retort.

The question as to just how much agitation of the coal is desirable during carbonization has not been clearly settled. It was found, however, that the capacity of Retort No. 25 was very considerably decreased by removing half the paddles—i.e., using only the number of paddles adopted in the Clinchfield type of retort. Since the paddle speed during this test was still nearly twenty times that used at Clinchfield, it is very likely that the agitation of the coal in the Clinchfield retorts is very far below the optimum for high capacity of retort.

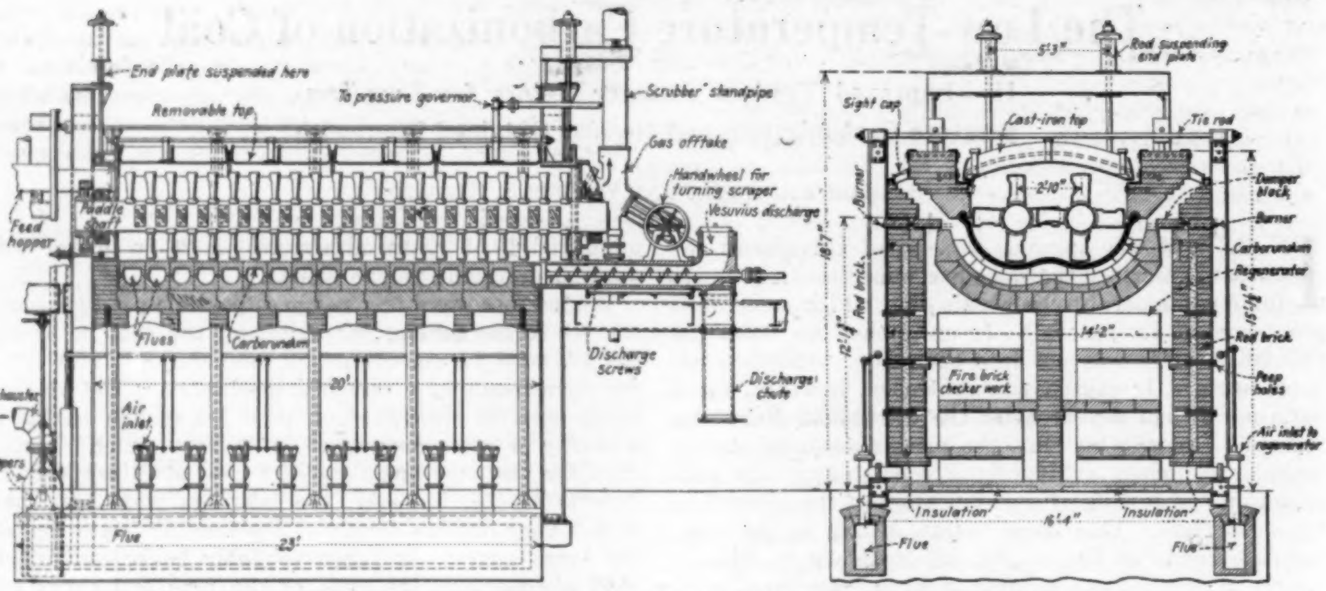
Removable Top for Retort

This represented a very considerable improvement in Retort No. 25 as compared with the Clinchfield retorts. In the first place, the cost of the cast-iron top is much less than the cost of the carborundum which it replaces. But its big advantage lies in the fact that the time of shut-down required to clean the carbon deposit from the retort wall is greatly reduced. At Clinchfield it requires a minimum of 12 days to cool a retort, clean it out and bring it back into operation. The last time Retort No. 25 was cleaned out the total time of shut-down was 32 hours. When it is considered that a retort must be cleaned once every 60 to 90 days, it will be seen that the removable top is a great advantage. As a minor point the comfort of the workmen cleaning



GAS OFFTAKES, PRIMARY RETORTS

[1]*Chem. & Met.*, vol. 28, No. 1, p. 11, Jan. 3, 1923.



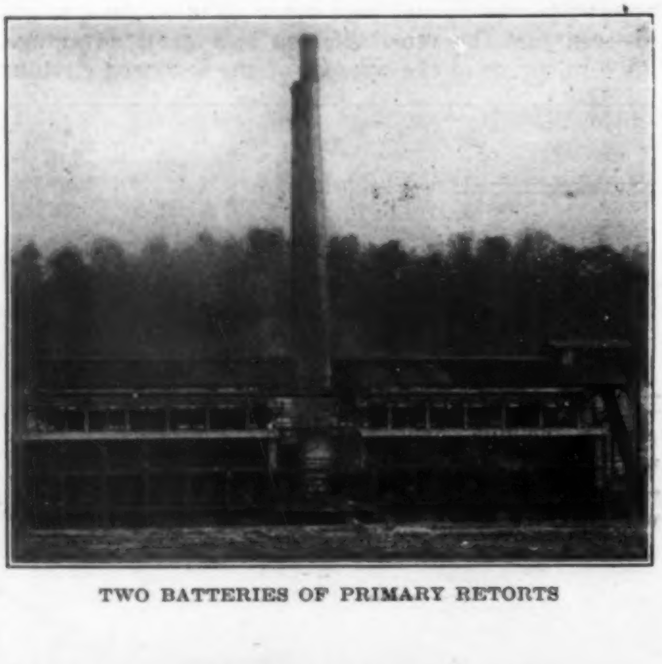
FIGS. 1 AND 2—RETORT NO. 25, A MODIFICATION OF THE CLINCHFIELD TYPE OF RETORT

the retort may be mentioned. The men don't mind how hot it is underfoot when they have head room and plenty of air, but they have to be driven to crawl into a hot retort through a manhole.

Heating System

The heating system on Retort No. 25 was much superior to that used on the Clinchfield retorts. Aside from any increased thermal economy to be secured through use of a regenerator type of furnace in place of a recuperator type, the use of regenerators on Retort No. 25 gave a cheaper furnace. The height of the Clinchfield retort above the foundations is over 25 ft., while the height of Retort No. 25 was only 15 ft. The burners on the Clinchfield retort are located in a tunnel underneath the retort, the flames impinging against the retort near the bottom. These burners are troublesome to operate and the burnerman cannot observe the flues without making a long climb to the top of the retort.

On Retort No. 25 the gas manifolds ran along either side of the retort with the flames passing down the flues and under the retort. The burnerman could at all times watch the flues through peep holes, and this aided very materially in getting good temperature control.



TWO BATTERIES OF PRIMARY RETORTS

Discharge Mechanism

In the Clinchfield type of retort the carbon residue from the retort drops down a vertical chute about 6 ft. long. A pair of breaker arms at the bottom of the chute break up the larger pieces and a pair of overlapping screws carry the material out and force it up over a dam which serves partly to seal the retort. This whole discharge arrangement is a mechanical abomination. The chute serves as a sort of chimney into the retort and the stacking effect of the hot gas therein draws air into the retort unless a relatively heavy gas pressure be carried in the retort. The sealing arrangement at the end of the discharge screws, known as a "Vesuvius" discharge, throws a heavy load on the discharge machinery and causes the gears, pinions and screw flights to wear out rapidly. It operated so poorly that it was eventually abandoned at Clinchfield and the hot carbon residue permitted to fall directly from the screws onto the conveyor belt.

On retort No. 25 the discharge chute and breaker arms were eliminated and the screws moved up to a position just below the floor level of the muffle. Two pairs of discharge screws were used in place of one pair. Unfortunately, the "Vesuvius" discharge at the outer end of the discharge screws was retained. Also there was no means provided for opening the inner end of the discharge screw housing to permit removal of tramp iron which occasionally gets into the retort with the coal and stalls the screws.

While the discharge mechanism of Retort No. 25 represents a considerable advance over the Clinchfield arrangement, it is believed that there is room for much improvement in this mechanism.

Gas Offtake

The gas offtake on Retort No. 25 was almost identical with that on the Clinchfield type of retort. The offtake was at the top of the discharge end casting of the retort. The gas issuing here was passed up through a vertical scrubber standpipe to the foul gas main, with a liquor spray operating in the standpipe. The hand-operated scraper or reamer for the gas offtake as used at Clinchfield was somewhat modified by gearing it to a

hand-operated driving shaft, and a screw thread was cut on the stem of the scraper in order to advance it regularly into the offtake. This scraper worked satisfactorily on Retort No. 25, but a similar installation on the Clinchfield retorts failed completely.

It is thought that the gas offtake and scrubber standpipe could be much improved. There is considerable objection to spraying the foul gas between the pressure governor (Tagliabue at Clinchfield; Smoot on Retort No. 25) and the retort, since the good effect of the governor is partly neutralized by the varying conditions of the spray in the scrubber standpipe.

Operation Data

Retort No. 25 was put under heat in January, 1921. After about 3 weeks' operation, fire destroyed most of the Irvington plant. Repairs were completed by the end of March and several more test runs made in April and May.

It was found very easy to control the temperature on Retort No. 25. Seven thermocouples were located in the retort shell at various points, with one couple in the gas space at the feed end and one couple in the gas space at the discharge end of the retort. With a shell temperature of 1,350 to 1,400 deg. F. (732 to 760 deg. C.) the retort would readily handle 1,700 lb. of coal per hour, reducing the volatile from 35 per cent in the coal to 14 per cent in the carbon residue discharged. Under these conditions the temperature in the gas space in the feed end of the retort was approximately 665 deg. F. and in the discharge end 1,035 deg. F. The retort made approximately 2,650 cu.ft. of gas per ton of coal carbonized, the gas having a calorific value of over 900 B.t.u. and often running as high as 1,000 B.t.u. (light oil vapors not removed). The fuel gas consumption per ton of coal carbonized was approximately 2,250 cu.ft., or about 85 per cent of the gas generated. In battery formation, with better regulation, the fuel gas consumption would no doubt be less.

The tar made was a light, mobile tar of specific gravity about 1.07 at 60 deg. F., the yield being approximately 25 gal. of dry tar per ton of coal.

The following data on one test run of 8 days illustrate the general character of the results obtained in all the tests:

1. Coal used: Pittsburgh Terminal coal (Pennsylvania) 162⅓ tons (dry).

	Dry Basis
Combustible volatile, per cent	35.3
Fixed carbon, per cent	57.9
Ash, per cent	6.8
Total	100
Sulphur, per cent	1.78
Nitrogen, per cent	1.66
B.t.u.	13,925

Coal dried to a moisture of about 1.9 per cent before carbonized.

2. Rate of feed, average 1,691 lb. per hour.
3. Retort shell temperature, average 1,392 deg. F.
   Temperature in gas at feed end, average, 610 deg. F.
   Temperature in gas at discharge end, average, 1,058 deg. F.
4. Gas made per ton dry coal carbonized, cu.ft. 2,660
   Average B.t.u. 899
   Highest average B.t.u. for any 24 hr. 1,010
5. Fuel gas used, cu.ft. per ton coal carbonized............2 406
6. Dry tar per ton of coal, gal. 24.8
   Specific gravity of dry tar at 60 deg. F............ 1.0783

Distillation of tar: (Sample 2/9/21 to 2/12/21).

Fraction	Per Cent by Volume	Sp.gr. of Fraction	Per Cent Tar Acids in Fraction
0-170° C.	2.77	0.8423	21
170-230° C	13.88	0.9235	36
230-270° C.	13.10	0.9828	47
270-300° C.	10.51	1.0071	38
300-310° C.	5.49	1.0193	37
Pitch	54.25 (M.P. 175.3 deg. F.)		

7. Carbon residue, estimated yield, per cent............83.7
   Combustible volatile in dry semi-Carbocal, per cent...14.02

The foregoing results are remarkably good for a commercial-size retort. Unfortunately, experimental work at the Irvington plant was discontinued in the spring of 1921. It is planned, however, to rebuild Retort No. 25 eventually, and set it up with the improvements which have been developed during the past year. A test based on several months' continuous operation can then be made.

The New Idea in Trade Association

Equipment Association Differs Essentially From Single-Commodity Group in That Its Major Interest Lies With Equipment Users

By Roberts Everett
Secretary, Chemical Equipment Association

FOR 50 years there have been trade associations in the United States—one or two manufacturers' associations are of that age. Since shortly before the war, and with the increase most of course during the war, there have come into existence about 5,000 American organizations classified as trade and industrial or allied associations until, as an article in a New York newspaper recently said:

> Industry has been wittily compared to the medical profession and to the labor unions. Just as a consulting specialist will examine a patient as far down as the fourth vertebra but no further, and a pipe fitter will fit a pipe but not perform the next operation, so even obscurely small processes or manufacturing groups in industry are limiting themselves in organizations for combined self and public interest.

These associations, almost without exception, are composed of manufacturers of a single product—for example, machine tools, lumber, coal or bread.

The trade association motive and its distinguishing method, as represented by and expressed in these single-commodity organizations, have been and are quite obvious. The motive has been selfish—the promotion of the internal welfare of member companies or of the entire industry of which they are members; and the method, the promotion of those companies' common product as against some competitive product, the obtaining of legislative advantages for themselves as a group, the development of cost-accounting methods for their more intelligent common action, etc.

Searching for the Common Interest

In the last few years, however, a new idea in trade association has found expression. Its origin may be discovered in the equipment fields of a few important industries, and the idea itself is a reflection of an inherent relationship between industrial equipment of any sort and the field or fields in which such equipment is used. This new idea has expressed itself in motives no less selfish than those of the older, more numerous type of trade association; but in its method is its novelty.

Equipment companies, except they are manufacturers of a single item of equipment—for instance, spark plugs for the automobile industry, or ovens for the baking industry, or tanks for chemically based industries—have not among themselves the same things in common as have the manufacturers who, in any single industry, employ the diversified machinery, apparatus and supplies which a representative group of their equipment companies produce. Automobile manufacturers, or wholesale bakers, or dye producers, have identical problems in their separate industries, identical interests

throughout the whole range of their businesses, because the product which they make is common to them all. But what of the companies which produce the manifold equipment that these manufacturers in single industries employ?

Their interests, their problems, their constant concern are not so common. Even in manufacturing, for instance, their problems are not universally alike, for one class of equipment may be based on iron or steel, another on non-ferrous metal, another on wood, another on paper; one may depend on mechanical equipment, another on human craftsmanship; one on plant, another on science. But how about distribution? Only loosely are the selling interests of equipment manufacturers the same. One may distribute his product by registered parcels post; another may require a flat car to move a single item. Then is it cost accounting? No, for costs and cost-finding methods vary with the variety of equipment. Legislation? One equipment producer may depend for his raw material upon a foreign country and is therefore interested in a low tariff; another may require protection to make money. In one association successfully embodying the new idea in trade associations today are members whose "plant" consists of a laboratory, a stenographer and a shipping clerk, and other members whose capitalization runs to $20,000,000 and whose factories and offices dot the entire country.

The New Idea

Obviously, an entire group of equipment manufacturers—or to put it another way the manufacturers of the entire range of equipment essential to the life of any single industry—have just one broad thing in common: *Their direct interest in that industry or group of allied industries which use their equipment.*

So the new idea in trade associations—an idea being successfully exemplified today—comes down to this: To perfect an organization based on common interest not in the promotion of a product common to a group of companies, but in promotion of a group of altogether external industries which bear the relation to the members of the organization of buyer to seller. The equipment manufacturer finds himself directly, abruptly and inescapably affected by the prosperity or poverty, the progressiveness or inertia, the optimism or discouragement of the industries which use his varied but essential products.

The new idea in trade associations reveals itself in equipment organization, as has been said, in method. An equipment association, just as naturally and obviously as does a single-commodity association, seeks primarily the protection of its members' business interests and those interests' advancement. But to find this it must survey the field of the users of the products which its members make; it must not merely "work for the buyer as well as for the seller," it must "work for the buyer because therein only can it work for the seller." To protect its interests and to increase them, it must safeguard its relationships already established with the buyer, and then advance that buyer's business so that the scope of such relationships may likewise widen.

The new idea in trade associations, then, brings the equipment group whose products are at the manufacturing base of an industry or an allied group of industries into the organized democracy of modern industry with a fundamental basis and purpose of constructive good will toward the industries which it supplies. It enlists the equipment group in the active, progressive development of the direct markets to which its equipment goes. It makes the equipment man an active agent in the development of his customers' and his prospective customers' affairs.

Activities of the Equipment Association

What are some of the logical activities of an equipment association? One is market expansion, another is educational market cultivation. Included in the first class is such co-operative work as the Chemical Equipment Association is now undertaking with the government in relation to export markets. Included in it is such clearing to its membership of domestic market information as the Chemical Equipment Association is now performing. Many other phases of market expansion are possible, even reaching to the public as a whole, if necessary.

In the second class may be included all activities which begin or end with a co-operative study of a particular industry's methods of manufacture, its use of equipment, the possibilities of adapting equipment used successfully in one industry to the more economical performance of an allied industry's manufacture, or accordingly, activities that result in better education in the use of equipment. Again using the Chemical Equipment Association as an example, one of its purposes is to "collect and disseminate information as to design, raw material and construction," obviously an activity which calls for co-operation with the industries using the equipment in establishing the most effective designs, construction and raw material possible. Another purpose of the Chemical Equipment Association, as still another example, is to "promote a better knowledge of conditions controlling the industry's development"—surely calling for the highest form of constructive co-operation with the manufacturing industries using chemical equipment.

Both of these classes of activity—market expansion and what is here termed as a very inclusive phrase, educational market cultivation—are premised on the user's needs. They both lead back to palpable, substantial benefits to the equipment group, but only through the latter's having actually engaged itself with the welfare and the needs of the user.

Research work and standardization work are two more logical activities of an equipment group. The Chemical Equipment Association, for instance, has as one of its purposes the standardization of trade phrases. Both these activities imply initial and constant consideration of the user's needs.

Business Ethics

Perhaps most important of all its natural activities is the prevention of trade abuses. One successful equipment association has gone so far as to establish a code of commercial practice which practically affords financial redress to the holders of equipment purchased through misrepresentation. It is true that such a defining of the honorable and the dishonorable in business affords a protection against unscrupulous action to the equipment manufacturer also. But that it protects him as well, in a manner otherwise probably impossible, does not lessen the fact that such activity by the equipment association foremost and signally protects the user.

Publicity—not merely for equipment manufacturers, but constructively for the industries which use equipment—the general encouragement of high standards in

the allied using industries, legislative action when such action supports the interests of a using industry—these and still others that can be instanced are logical activities of an equipment association.

Constructive Influence Exerted

In a few industries which have been fortunate enough to develop trade associations at their supply and equipment ends, these associations have won a rapid esteem for the constructive influence they have exerted. An authoritative report to one industry in which such an equipment association exists, an industry in which certain unfortunate conditions prevailed at its inception, has cited that the association "in two short years has done very much to change the general conception of the industry from that of something undignified to something dignified, important and progressive." In another very important industry, the activities of an equipment association through certain standardization work and the adoption of certain general policies of relationship toward the using industry have automatically saved the latter amounts perhaps incalculable over a number of years.

Association Advantages

Nor is it to be concluded, simply because in its method the nature of equipment forces the employment of a new idea, that an equipment association proves negligent in its results to its own members. In return for its constructive interest in the industries which its members supply, those members attract an invaluable good will, an identification that goes beyond the merely commercial. Their association automatically becomes a receiving station of invaluable trade news, of business to be placed, of activities pending, that is cleared to them for immediate and confidential use. Their committees' findings in investigations of trade matters, their officers' contact with government officials and agencies, give its members inevitably informational assets and a prestige of position that brings directly traceable returns.

It has already been demonstrated in a number of fields that the industries using equipment have themselves expanded appreciably through the activities of the equipment trade association. In such expansion, it is only natural that the informational assets and the prestige of position which the members of an equipment organization enjoy give them some advantage in sharing in this new equipment business.

New York City.

Manufacture of Cordage and Twine, 1921

The Department of Commerce announces that reports made to the Bureau of the Census show a decrease in the activities of the establishments engaged primarily in the manufacture of cordage and twine during the year 1921 as compared with 1919. The total value of products reported amounted to $74,712,000 in 1921, and to $133,366,000 in 1919, a decrease of 44 per cent.

In addition, rope, cordage and twine to the value of $3,473,000 in 1921 and $9,163,000 in 1919 were reported by manufacturers whose chief products were jute and linen goods. Also, cordage and twine valued at $8,958,000 were reported in 1919 by cotton mills and establishments in other industries; corresponding figures for 1921 are not available at this time.

Legal Notes

By Wellington Gustin

Cancellation Provision Renders Contract Covering Purchase and Sale of Iron and Steel Bars Unenforceable

A little provision crept into an important contract between the Northwestern Bridge & Iron Co. and the Interstate Iron & Steel Co. which the United States Circuit Court of Appeals has held to make the contract unenforceable, and the U. S. Supreme Court upholds this court by denying to the plaintiff a writ of certiorari bringing up the case for further consideration. (278 Federal, 51.)

The Northwestern Bridge & Iron Co. of Milwaukee was a fabricator and erector of structural iron and steel and the Interstate Iron & Steel Co. was a manufacturer of iron and steel, with rolling mills at Marion, Ohio, East Chicago, Ind., and South Chicago, Ill. In March, 1917, they entered into two agreements, one respecting iron bars and the other steel bars. Both agreements were on the regular printed sales contract form of the seller steel company.

The Northwestern Bridge & Iron Co. brought suit on the two agreements for damages for breach by the steel company for failure to manufacture and deliver 200 tons of iron bars and 200 tons of steel bars, less a small amount of each shipped. Before the trial court it obtained a judgment for $35,259.37 damages against the steel company.

Clause Which Rendered Contracts Unenforceable

On the appeal the judgment was assailed upon various grounds, but the one which goes to the root of action is the contention that the contracts are not enforceable because of the clause in the contract reading:

"It is understood that if the tonnages are not specified as called for in this contract they shall be automatically cancelled."

Similar Cases Cited

In the suit the manufacturing seller set up that this provision left it entirely optional with the buyer to take or not to take any or all of the tonnage, and, no consideration appearing for the agreements to sell, neither party became obligated by the contracts. On this question a nnmber of decided cases were cited and the Court of Appeals found that contracts with provisions more or less similar, but involving substantially the same principle, have been held to be unenforceable. In American Cotton Oil vs Kirk, 15 C. C. A., 540 the memorandum of sale of 10,000 bbl. of oil provided "deliveries to be made per week as Kirk & Co. [buyers] desire." Passing on the validity of this contract, the court said:

"Suppose Kirk & Co. had not desired and had not ordered any such quantities as would require 100 years to complete the delivery—is there any way open to the defendant to put plaintiffs in default? We think not, and that there is no mutuality of promises for the sale of a definite or ascertainable quantity of oil."

In Oakland Motor Car Co. vs. Indiana Auto Co., 201 Federal, 499, the agreement was for sale of automo-

biles wherein there were provisions that no order shall be binding unless accepted by the manufacturer at least 30 days prior to date of delivery, and for cancellation by either party for just cause. There was no question, says the court, that the provision for cancellation alone would have rendered the contract unenforceable. But it was contended that the qualification "for just cause" saved the contract from the operation of the rule. The court held that the addition of those words did not exempt the contract from the application of the rule requiring the mutuality of obligation as a necessary element of a binding contract for future sale and delivery.

A provision in a contract of sale requiring the buyer to make periodical specifications of his requirements of products of substantially equal quantities is not a mere formality to be observed or not, but a material provision, and the parties will be held to its observance, especially where the seller is a manufacturer and the articles are of various dimensions, which the manufacturer cannot know until the buyer specifies them.

Where Printed and Written Provisions Are Inconsistent, Latter Prevail

Again, the court says, every part of a written instrument should be given effect so far as possible. But it was urged that in the printed form of the contract there is recited a sale and purchase of the iron and steel bars, and therefore in order to give effect to this part of the contracts they should be held to be sales rather than options to purchase. The rule of law is that where there is irreconcilable difference between formal printed portions of an instrument and other parts of it which are written in the latter will prevail. If the effect of this special clause is to make it optional with the buyer whether he will take any of this tonnage, this is inconsistent with the recited sale and purchase, and the special clause would prevail. The words "buy" and "sell" express a conclusion, and if the things actually agreed upon fall short of making a contract of purchase and sale, then no such contract is effected. Now from the contract it appears that these parties were dealing with something which had no existence and could therefore not be the subject of a present sale, but the subject matter of the contract had first to be manufactured after the buyer made timely requisition therefor as in the contract provided.

Buyer Did Not Specify Tonnages

For over 3 months after the contracts were executed the buyer did not see fit to make any specifications whatever, although the contract provided for substantially equal monthly tonnages during the contract period. The buyer had every reason to believe that the special provision for automatic cancellation operated to cancel each month's tonnage, where no specification was given. The court says it surely could not expect to wait until the end of the contract period, and then, if deemed advantageous, order out the entire 400 tons.

And the provision that if the tonnages were not specified as called for therein, they should be automatically canceled was not a mere provision for the protection of the seller, to be exercised by it or not at its option, especially where another part of the contract provided for cancellation by the seller at its option in case of delay in payment.

Neither did the seller steel company waive its right to set up the invalidity of the contracts because of the provision for automatic cancellation, by disputing the buyer's right under the contract to specify greater widths than 6 in., instead of asserting the invalidity of the contract, or by offering to supply the entire tonnage ordered in lesser widths, it previously having called attention to the provision for automatic cancellation. This claim of waiver of conditions in the contract on the part of the seller arose out of specifications submitted for the steel of greater widths than contemplated under the agreements. The court says the seller might have been willing to supply the full tonnage of the smaller width steels and iron. But this waived nothing, and was merely a proposal to enter into another agreement to supply at the contract prices tonnage which, had the agreements been valid, would at that time have been largely canceled.

Again, there appears no such situation as was present where contracts seemingly somewhat similar have been upheld, such as contracts to supply a buyer's entire season's requirements, to take a manufacturer's entire output, to sell to the buyer alone all the seller may acquire of a particular article for a definite time. But the two contracts in question in this case left the buyer with the unqualified right, and with entire impunity, to cancel the contracted tonnage from month to month until at the end of the time fixed none of it remained; both parties being free to buy or sell elsewhere as they saw fit. Such contracts are in quite a different class from those just mentioned. The latter are unenforceable and hence invalid.

Iron Ore Produced in 1922

The iron ore mined in the United States in 1922, exclusive of ore containing more than 5.5 per cent of manganese, is estimated at 46,963,000 gross tons, an increase of 60 per cent as compared with that mined in 1921. The ore shipped from the mines in 1922 is estimated at 50,046,000 gross tons, valued at $158,222,000, an increase of 88 per cent in quantity and of 76 per cent in value as compared with the figures for 1921. The average value of the ore per gross ton at the mines in 1922 is estimated at $3.16; in 1921 it was $3.37. The stocks of iron ore at the mines, mainly in Michigan and Minnesota, apparently decreased from 13,836,267 gross tons in 1921 to 10,699,000 tons in 1922, or 23 per cent.

These estimates, which are based on preliminary figures furnished by producers of 98 per cent of the normal output of iron ore, were made by Hubert W. Davis, of the United States Geological Survey, Department of the Interior. They show the totals for the principal iron-ore producing states, and, by grouping together certain states, the totals for the Lake Superior district and for groups of southeastern and northeastern states.

Imports and Exports

The imports of iron ore from Jan. 1 to Sept. 21, 1922, amounted to 684,387 gross tons, valued at $2,894,496, or $4.23 a ton. The imports for the year 1921 were 315,768 gross tons, valued at $1,075,909, or $3.41 per ton. The exports of iron ore for the 11 months ended Nov. 30, 1922, amounted to 602,095 tons, valued at $2,770,160, or $4.60 a ton, as compared with exports for the entire year 1921 of 440,106 tons, valued at $2,077,620, or $4.72 a ton. The statistics of imports and exports were compiled from the records of the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

Book Reviews

CHEMICAL ENGINEERING CATALOG. Seventh edition. The Chemical Catalog Co., Inc., New York.

This very useful publication which appears for the seventh year is now almost a standard reference book for chemical engineers. There need be no lengthy descriptive review, as the scope of the book is well-known.

It is a little too top-heavy on laboratory ware with the 65-page catalog of the Will Corporation inserted bodily, but I see no satisfactory solution to that particular problem. The Classified Directory is well made up and extremely useful. In the next edition I would suggest slightly less body to the type in which the subject headings are printed. A more graceful type would make the directory pages easier on the eyes.

The list of scientific and technical books is more complete than in past years and should prove valuable, although the publishers are usually more than generous with catalogs and this is, I should say, the least useful part of the book.

CHARLES WADSWORTH.

VAN NOSTRAND'S CHEMICAL ANNUAL. Edited by *J. C. Olsen.* Fifth issue, thoroughly revised and enlarged, 1922. D. Van Nostrand Co. Price, $4 net.

There must be thousands of chemists (I know scores of them personally) who have had occasion to bless this useful book. Especially when one is at some distance from an adequate library where large reference books are available, it is invaluable to have such a compendium. Even with large books at hand, the convenience of using a little book is a big item in its favor. I should therefore conjure the editors not to expand it much further. It is bound to be incomplete, but in its selective incompleteness lies its merit. Keep it small.

To those who know nothing of this book I recommend an introduction by purchase. It will be impossible to discuss the handbook adequately for the complete stranger in a review. As chemist and chemical engineer I have found it a friendly companion and have frequently started on trips with Olsen and a slide rule.

The new edition contains more specific gravity tables, additional vapor tension tables and some table of properties of important elements. These are all sane additions. The specific gravity tables will be especially useful.

It is often a disappointment to find such meager data on solubility, but in all cases checked this has been due to the absence of data and not to any editorial oversight. The establishment of a solubility determination verein seems to be in order. The fifth edition is worthy of its predecessors.

CHARLES WADSWORTH.

Recent Chemical & Metallurgical Patents

American Patents Issued Jan. 9, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be stud:ed later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,441,203-4-5—Process of Manufacturing Artificial Silk and Other Products From Nitrocellulose. E. Bindschedler and G. Juer; assigned to Tubize Artificial Silk Co., Hopewell, Va.

1,441,206—Guanidine Salts. J. S. Blair and J. M. Braham.

1,441,219—Fertilizer Stock. A. Ehrenreich and Allen Rogers; assigned to Ocean Leather Co., New York.

1,441,243—Tanning Liquor From Cellulose Waste Sulphite Lye. A. Romer, Stuttgart.

1,441,341—Recovery of Aromatic Compounds. F. X. Govers, New York.

1,441,417—Purification of Hydrocarbons. D. F. Gould; assigned to The Barrett Co.

1,441,541—Acetyl Cellulose. W. J. Stevenson, London, England.

1,441,542—Method of Treating Oil-Bearing Shale. H. R. Straight.

1,441,568—Electrodeposition of Copper. C. G. Fink; assigned to Chile Exploration Co.

1,441,573. Manufacture of Phosphorus. R. Franchot and K. P. McElroy; assigned to Ferro Chemicals Co., Washington, D. C.

1,441,598—Product From Furfural and Process of Manufacture. M. Phillips and G. H. Mains, Detroit.

1,441,605—Waterproofing Composition. C. D. Shaffer; assigned to Textile Leather & Metal Preserver Co., Kalamazoo, Mich.

1,441,612—Chrome Pigments—Norman Underwood, Oakton, Va.

1,441,655 — Manufacture of o-Sulphonic Acids of Aromatic Amines. F. Boddiley, J. B. Payman and H. Wignall; assigned to British Dyestuffs Corp., England.

1,441,664—Manufacture of Ink. Roy Cross, Kansas City.

1,441,694—Process of Making Fertilizer. K. P. McElroy; assigned to Ferro Chemicals, Inc., of Washington.

1,441,695—Process of Fixing Nitrogen. K. P. McElroy; assigned to Ferro Chemicals, Inc., of Washington.

1,441,696—Absorbent for Gases. C. P. McNeil and E. P. Brown, Whiting, Ind.

1,441,982—Artificial Resins. A. Heinemann, Berlin, Germany.

1,441,989 — Production of Cellulose Ethers. Leon Lilienfeld, Vienna, Austria.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Limekiln — Valentine Arnold, of Woodville, Ohio, has patented certain improvements on a limekiln. These consist substantially in constricting the kiln above the burning zone so as to have it act as a gas choke. This burns the lime more effectively than is possible under the present conditions. The other improvement is the change in shape of the kiln from circular to rectangular below the burning zone. A distinct operating advantage is claimed for this improvement as well as the other. (1,439,597. Dec. 19, 1922.)

Synthesis of Ammonia From Its Elements—J. C. Clancy, of Niagara Falls, N. Y., has assigned to the Nitrogen Corporation of Providence two patents (1,439,291 and 1,439,292), both of which have to do with the preparation of a catalyst which is claimed to be an improvement on his already patented process. The catalyst in brief is made from calcium ferrocyanide by immersing small lumps of pumice about the size of a pea in a solution of pure calcium ferrocyanide, which is sulphur free, etc. The solution is then evaporated to dryness and the lumps of pumice are dried further. Finally, they are put into an autoclave and heated gradually up to a temperature of 350 deg. for a number of hours. As the temperature increases air or oxygen must be excluded from the autoclave, and this is usually done by displacing them with hydrogen and nitrogen. The improvement in the process consists in finally-heating the catalyst in the presence of ammonia for a number of hours at a temperature which is somewhat more than 400 deg. but below 650 deg. A catalyst prepared in this way is very much more durable and can be used for upward of 40 days instead of 25 days. (1,439,291 and 1,439,292. Dec. 19, 1922.)

Apparatus for Solvent Recovery—W. K. Lewis and William Green, of Newton, Mass., have developed a process for the recovery of solvents used in applying rubber to belting and other fabric. The patent is much broader than this specific case, however, and the principles may be applied to a large number of processes. The drawings and details of the process are somewhat too complicated for a brief review. Briefly, the solvent is removed from the belting by means of heated flue gases in a closed chamber. The advantage of using flue gases here is that it eliminates the use of air, with which benzol particularly forms a very explosive mixture. The flue gases and benzol vapors then are pumped through a tower suitably packed and through which is flowing a stream of heavy hydrocarbon oil, which absorbs the benzol (or gasoline). The flue gases then continue through the cycle, are somewhat preheated first and then passed into the chamber in which the

belting is dried. The solution of benzol (or gasoline) in oil is then pumped through heat exchanges and through a still, which removes the benzol (or gasoline) from the oil, which in turn is returned to the tower for absorbing more solvent. The use of high vacuum, the injection of steam into the still, and the use of the counter-current flow principle throughout the system are among the unique characteristics of the process. (1,437,980. Dec. 5, 1922.)

Process for the Manufacture of Compressed Hydrogen—Georges Claude, of Paris, France, has assigned this patent to L'Air Liquide Société Anonyme pour L'Etude et L'Exploitation des Procédes Georges Claude, of Paris, France. The process consists essentially in compressing hydrogen to from 50 to 300 atmospheres and then absorbing all the other gases which are normally associated with it, such at methane and carbon monoxide, in ether at a temperature of approximately —60 deg. C. Curiously enough, at moderate pressures of 300 atmospheres and at very low temperatures the differential solubility of carbon monoxide and hydrogen is very much greater than it is at ordinary pressures and temperatures. Advantage is taken then of this fact in separating the carbon monoxide from the hydrogen. The other gases have a higher differential and do not present so serious a problem. (1,438,581. Dec. 12, 1922.)

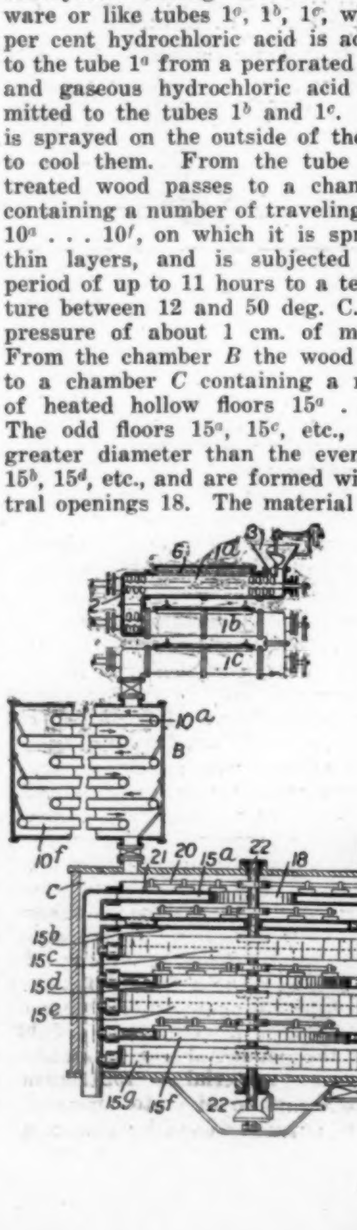
Urea Phosphate—German patent No. 286,491 describes the manufacture of urea phosphate by treating phosphoric acid with urea. Fuller Clarkson and Joseph M. Braham, of Washington, D. C., have attempted to prepare this substance, which is so excellently suited for a fertilizer, by following the specifications given in this patent which recommended adding to about a 50 per cent solution of phosphoric acid the corresponding amount of urea, and heating until all the urea went into solution, filtering and crystallizing. It was found that no crystals could be separated out unless a few crystals of urea phosphate were added to the solution to induce crystallization and that at best the maximum yield obtainable was 31 per cent. The conclusion was that urea phosphate cannot be made in accordance with the process described in this patent and this led to a series of experiments in which were studied the effect of varying the concentration of the reacting substances, the temperature of the solution and the crystallization temperature. It was found that an acid concentration considerably above 50 per cent is desirable, and further that the exact ratio of concentration of acid and urea in solution is not of great importance. They recommend the use of a 75 per cent solution of phosphoric acid and the addition of equi-molecular amount of urea in solutions. (1,440,056. Dec. 26, 1922.)

Apparatus for Extracting Valuable Material—W. C. Graham, of Denver, Colo., has patented an apparatus in which soluble matter is extracted from such materials as shredded or finely divided sugar beets or like material. The principle of the apparatus is to feed the finely divided material into a hopper with a screen in it and to wash it through the screen and subsequently through a large pipe or conduit by means of a centrifugal pump into a chamber. Here it is packed by the pressure of the pump. The chamber into which the finely divided solid flows is very large and consequently the solvent liquor, water in most cases, would reach a very high concentration during transit. (1,437,801. Dec. 5, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Glucose and Dextrine—In the process for obtaining dextrine and glucose from wood by treating it first with liquid and then with gaseous hydrochloric acid as described in the parent specification, the wood after treatment with acid is spread into thin layers and allowed to digest. The resulting material is of a loose powdery texture so that the acid can easily be extracted from it. The material is carried by worm conveyors 2 through a series of stoneware or like tubes 1^c, 1^b, 1^c, while 40 per cent hydrochloric acid is admitted to the tube 1^a from a perforated pipe 6, and gaseous hydrochloric acid is admitted to the tubes 1^b and 1^c. Water is sprayed on the outside of the tubes to cool them. From the tube 1^c the treated wood passes to a chamber *B* containing a number of traveling bands 10^a . . . 10^f, on which it is spread in thin layers, and is subjected for a period of up to 11 hours to a temperature between 12 and 50 deg. C. and a pressure of about 1 cm. of mercury. From the chamber *B* the wood passes to a chamber *C* containing a number of heated hollow floors 15^a . . . 15^g. The odd floors 15^a, 15^c, etc., are of greater diameter than the even floors 15^b, 15^d, etc., and are formed with central openings 18. The material is carried over the floors by scrapers 21 carried by arms 20 on a central shaft 22 and passes through the openings 18 and over the edges of the floors 15^b, etc. The temperature is maintained at 15 to 30 deg. C. and the evaporated hydrochloric acid gas is removed, compressed and re-used. The material passes into another chamber similar to the chamber *C* but maintained at a temperature of about 50 deg. C. and a pressure below atmospheric. The vapors are passed through a washing vessel, so that the liquid and gaseous hydrochloric acid used are recovered in nearly their original forms. The treated wood is boiled in water and the resulting solution filtered, neutralized and concentrated or fermented. (Br. Pat. 186,139. H. Terrisse and M. Levy, Geneva. Nov. 15, 1922.)



Centrifugal Machine—In apparatus of the type in which centrifugal force is used to drive washing liquid from the periphery to the axis of the separator through separated solid matter by the provision of a peripheral annular space to which the washing liquid is conveyed by passages from the axis of the separator, filtering material is carried by ribs or the like provided on the inner surface of the separator casing. The washing liquid is

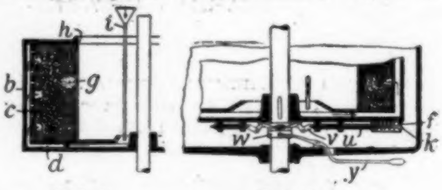


FIG. 1 FIG. 2

supplied through a funnel *i*, Fig. 1, and is forced centrifugally through passages or pipes *d* into an annular space formed between the outer periphery *b* of the separator and a filtering cloth *c* or other filtering material carried on ribs or the like on the periphery. The washing liquid then passes inward through the separated solid *g* and escapes at the overflow *h*. Various openings may be provided in the top cover to provide different outlets and thereby variable thicknesses of separated material. Perforated annular pipes or conduits may take the place of the ribs on the outer wall. After washing, the separated material may be projected in a dry state while the machine is running through an opening *f*, Fig 2, normally closed by a valve *k* actuated by a handle *y* through a sliding sleeve *w*, bell crank levers *v* and rods *u*. (Br. Pat. 187,429. Chemische Fabrik Griesheim-Elektron, Frankfurt-on-Main, and F. Sander, Griesheim-on-Main. Dec. 13, 1922.)

Ink—Printing-ink is made by treating waste sulphite-cellulose lyes with nitric acid and a catalyst, preferably metallic copper or zinc, the product being used with coloring matters such as prussian blue and cinnabar, or being treated with sulphuric acid before the first reaction is completed to produce a black ink. (Br. Pat. 187,537. K. J. Smidt, Copenhagen, and R. Jaeger, Berlin. Dec. 13, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Arsenic Investigation Report Predicts Shortage

Government Bureaus Believe Urgent Demands Will Be Met and That Conservation Will Relieve Future Shortage

WHILE calcium arsenate supplies will not be entirely adequate for the requirements of 1923, supplies of white arsenic will be diverted from the manufacture of lead arsenate and from the manufacture of glass, thereby making available supplies sufficient to meet the more urgent demands. This is the purport of the report made jointly by the Bureau of Entomology and the Geological Survey in response to a Senate resolution. B. R. Coad, of the former, and G. F. Loughlin, of the latter bureau, are the authors of the report. They point out that there is an apparent shortage of about 5,000 tons of white arsenic in the supplies needed prior to May 1. It is admitted, however, that this shortage may be decreased by importations and by increases in production.

Industry Lacks Stability

There is great need, the report shows, for stabilizing the arsenic industry. It is apparent that the sources of supply are adequate and it is predicted that there will be sufficient white arsenic produced to meet the requirements of 1924 and subsequent years, provided the market can be kept sufficiently stable to encourage producers. Rapid increases in the demand for calcium arsenate may be expected, declares the report, "as the use of calcium arsenate as an insecticide has emerged from experimental stage."

Dr. Coad was given access to the books of the American Smelting & Refining Co., and of the United States Smelting, Refining & Mining Co. He has verified the statement of those companies that practically all of their output has been sold directly to the consumers and that their entire output until June 1 is under contract. The contract price for the material is around 9 cents per pound. The Anaconda Company also contracted for its output last October, so that the principal domestic producers, the report says, "are, therefore, unable to take advantage of the high prices (15 to 17 cents per pound in December, 1922) for any appreciable quantity of white arsenic. The conclusion is obvious that any recent speculation in white arsenic has been with imported material." Even in the case of foreign arsenic, it was admitted that such speculation as was discovered involves only extremely small amounts. No stock is taken in the rumors that large amounts of white arsenic are being held to influence the price.

With the view of stabilizing the arsenic industry, a co-operative study by the Geological Survey, the Bureau of Mines, the Bureau of Chemistry and and the Bureau of Entomology "of the appearance and supplies of arsenical ores, their reduction and the manufacture and use of arsenic compounds" is suggested in the report. Reference also is made to the benefits which will follow concerted action among producers, manufacturers and consumers.

The shortage of 1922 was brought about by the sudden slump in the demand for this material in 1921. The decline in the price of cotton made it impossible for the Southern farmers to buy. Apparently the manufacturers did not foresee the possibilities of heavy purchases in 1922. As a result prices reached a point early in 1922 where manufacturers were discouraged from adding to their stocks, which were unusually large at the beginning of 1922.

Early last year, the report points out, there was 8,000,000 lb. of calcium arsenate in warehouse storage. Southern banks, convinced that calcium arsenate had passed the experimental stage, were liberal in financing purchases and as a result stocks soon were exhausted. Altogether about 16,000,000 lb. of calcium arsenate was sold in 1922, without satisfying the demand.

It was not until the fall of 1922 that prices for white arsenic were high enough to stimulate production. The steady increase in production which began in 1914 was offset in part by a decline in imports. A part of that increase undoubtedly was due to war demands. The present demand for white arsenic is estimated by the Geological Survey to be 12,000 tons a year. The capacity of the white arsenic refineries is 18,000 tons annually. The Geological Survey also estimates that at least 25,000 tons could be saved each year as a byproduct in the smelting or arsenical ores in the Western states.

The present minimum annual demand for white arsenic is itemized by Dr. Coad as follows: Calcium arsenate, 3,500 tons; glass, 2,000 tons; lead arsenate, 2,000 tons; weed killers, 1,500 tons; paris green, 1,200 tons; dips, 1,000 tons; proprietary mixtures, 750 tons.

Ford Would Make Calcium Arsenate

That Henry Ford has under consideration the possibility of manufacturing calcium arsenate at Muscle Shoals, in case he should obtain rights there, was revealed in the course of debate in the House of Representatives on Jan. 16. Representative Wright of Georgia declared that the Detroit manufacturer is investigating to see if the manufacture of calcium arsenate cannot go hand in hand with the fixation of nitrogen.

Mr. Wright expressed the belief that "practically every big industry and financial concern in the United States is fighting the Ford offer." This led Representative Garner, the ranking member on the Ways and Means Committee, to suggest that the President himself is the most powerful opponent among those who have arrayed themselves against the Ford Muscle Shoals proposition.

Representative Hull of Iowa entered the debate to state that he is opposed to the Ford offer because Mr. Ford is insisting that Congress do an immoral act in proposing that it award to him something which the government does not own—the Gorgas steam plant.

Executive Order May Adjust Wage Scale of Federal Employees

An executive order may have to be issued to provide an adequate scale of salaries for professional positions in the government service. Congress has wrestled with this question for more than two years, and now as the session is about to close, the reclassification legislation seems to be jammed hopelessly. It is just possible that Congress, on learning that the President is prepared to meet this situation by an executive order, may compromise its differences and provide the long-needed legislation.

If an executive order is issued, it is believed the scale would be about as follows: Chief professional, \$7,500 and up; full professional, \$5,700 to \$7,500; associate professional, \$4,500 to \$5,700; assistant professional, \$2,460 to \$4,500; junior professional, \$1,860 to \$2,460.

Ceramic Society Plans Comprehensive Program

Symposia on Burning and on Consumers' Problems, With Question Boxes to Bring Out Valuable Discussion

For the silver jubilee convention of the American Ceramic Society, Pittsburgh, Feb. 12 to 16, the refractories division has prepared an exceptionally valuable program. General papers on various phases of the industry will be supplemented by sessions on burning and on consumers' problems. The question boxes, which have been found so helpful at recent meetings of the division, are designed to bring out discussion on important points which are not covered by the papers. The program of this division—and of the other divisions of the society as well—will be presented at the Fort Pitt Hotel, Pittsburgh, Tuesday and Wednesday, Feb. 13 and 14.

Following is the program:

Session on Consumers' Problems

1. Refractory Requirements for Stokers, George I. Bouton, Murphy Iron Works.
2. Refractories From Consumer's Standpoint in the Gray Iron Foundry Air Furnace, R. F. Harrington, Hunt-Spiller Manufacturing Corp.
3. Metallurgical Requirements of Refractories in Copper Smelting and Refining, Francis R. Pyne, U. S. Metals Refining Co.
4. Refractory Requirements for Oil Refining, Alan G. Wikoff, *Chemical & Metallurgical Engineering.*
5. Refractories in Malleable Iron Furnaces, H. G. Schurecht, U. S. Bureau of Mines.
6. Refractories and the Malleable Iron Plant, A. F. Gorton and Mr. Schwartz, National Malleable Castings Co.
7. Suspended Boiler Arches, J. E. Harlow, M. H. Detrick Co.
8. Metallurgical Requirements of Refractories, D. A. Lyon, U. S. Bureau of Mines.
9. Metallurgical Requirements of Refractories in the Gas Industry, W. H. Fulweiler, United Gas Improvement Co.
10. Metallurgical Requirements for Refractories in the Electrochemic Metallurgy of Zinc, B. M. O'Harra.
11. Metallurgical Requirements for Refractories in the Aluminum Industry, R. J. Anderson.
12. Metallurgical Requirements for Refractories for Furnaces Melting Copper Alloys, H. W. Gillett.

Question Box on Consumers' Problems

1. Is it necessary to inspect 9 in. sizes for dimensions? E. E. Ayars.
2. What specification limits should be considered as reasonable on dimensions of 9 in. fireclay brick? A. F. Greaves-Walker.
3. Will results in practice justify the expenditure and added cost necessary in order to make firebrick mixes from definite percentages of definitely sized clay grains? A. F. Greaves-Walker.
4. Should the softening point specifications on high heat duty firebrick be raised in view of the fact that consumers are gradually increasing temperatures, or should another classification be added with more severe requirements? A. F. Greaves-Walker.
5. Is a serious effort being made by manufacturers of fireclay refractories to produce 9-in. brick of full size standard dimensions? A. F. Greaves-Walker.
6. Is the A.S.T.M. spalling test too severe? If so, what changes are suggested? A. F. Greaves-Walker.
7. What is the effect of TiO_2 in amounts less than 2½ per cent on the fusion point of clay refractories? A. F. Greaves-Walker.
8. What is the best type of refractory brick to use in the side walls of air furnaces? C. E. Bales.
9. Does the use of powdered coal decrease the life of firebrick in malleable iron furnaces? C. E. Bales.
10. What is the cause of rapid failure of firebrick in the open checkerwork baffles of oil-fired boilers, subjected to a temperature of 2,300 deg., and against which the oil flame does not impinge? E. E. Ayars.
11. Is the present fusion point of the well-known brands of flint city refractories lower than it was on the same brands in 1900? A. F. Greaves-Walker.

Session on Burning

1. Burning Fireclay Refractories, E. H. Gartrell, Ashland Brick Co.
2. Use of Pyrometers in Burning Refractories, R. P. Brown, Brown Instrument Co.
3. Producer Gas for Burning Refractories, W. D. Richardson, Ceramic Engineering Co.
4. Burning Refractories, George A. Balz, Seaboard Refractories Co.
5. Notes on Burning Refractories, With Special Reference to Control of Labor Costs, L. C. Hewitt, LaClede-Christy Clay Products Co.
6. A New Tunnel Kiln, R. H. Miller.
7. Insulation of Periodic Kilns, J. H. Krusen, A. P. Green Fire Brick Co.
8. Burning Silica Brick, F. A. Harvey, U. S. Refractories Corp.
9. Changes in Constitution of Fireclays With Varying Heat-Treatment, A. A. Klein, Norton Co.
10. Discussion of Mr. Klein's Paper to be led by U. S. Bureau of Mines Men.

Question Box on Burning

1. Are Shaker Grates or Hand Stokers Suitable for Obtaining of Cone 20 in a Round Down-Draft Kiln? E. E. Ayars.
2. Is Oil Firing Adaptable to the Round Down-Draft Kiln in the Burning of Refractories at Cones 18 to 20? E. E. Ayars.
3. Is the Coal Consumption Per Thousand Brick at a Given Cone Higher With Low Volatile Coal Than With a High Volatile Coal When Burning Refractories Above Cone 10? A. F. Greaves-Walker.

General—Specifications, Resources

1. Some Thermal Studies, M. F. Beecher, Norton Co.
2. Analysis of High-Alumina Refractory Products, C. A. Underwood, American Refractories Co.
3. Progress Report on Tests for Firebrick Specifications, R. F. Geller, U. S. Bureau of Standards.
4. Chrome Refractories, J. S. McDowell and H. S. Robertson, Harbison-Walker Refractories Co.
5. Ganister of the Baraboo Range, Dr. W. O. Hotchkiss, University of Wisconsin.
6. Quantitative Status of the Flint Fireclays of Maryland and Kentucky, Prof. W. R. Jillson, Kentucky Geological Survey.
7. The Flint Clay Situation in Pennsylvania, Dr. G. H. Ashley, Pennsylvania Geological Survey.
8. The Flint Clay Situation in Ohio, Wilbur Stout, Ohio Geological Survey.
9. Refractory Possibilities of Some Georgia Clays, Prof. R. T. Stull, U. S. Bureau of Mines.
10. Prospecting for Fireclays, E. W. Hess, Clearfield, Pa.
11. Silica Cement, E. N. McGee, Semet-Solvay Co.
12. Refractory Products of France, R. V. Widemann, Paris, France.
13. The Slag Test, R. M. Howe, Mellon Institute.
14. Resistance of Certain Types of Brick to Action of Slags, R. M. Howe, Mellon Institute.
15. Effect of Certain Gases at Various Temperatures Upon Structure of Refractory Brick, R. M. Howe, Mellon Institute.
16. The Development of Apparatus for the Determination of Heat Transfer Values in Refractories, A. S. Watts and R. M. King, Ohio State University.
17. Some Investigation Concerning the Influence of the Alkalis and Alkali Earths on the Fusion Temperatures of the Different Types of Refractory Clays, A. S. Watts and R. M. King, Ohio State University.
18. British Silica Bricks, W. J. Rees, director of research, University of Sheffield, England.
19. Testing of Refractories, W. J. Rees, director of research, University of Sheffield, England.

Question Box

1. How close can the volumetric determination of Cr_2O_3 in chrome ore be made to check with the gravimetric determination? C. A. Underwood.
2. Are two precipitations of lime in magnesite sufficient, or should the method requiring one cold and two hot precipitations be employed? C. A. Underwood.
3. Can diaspore, bauxite and spinel be thoroughly decomposed by acid treatment? C. A. Underwood.
4. Does the presence of alkali sulphates interfere with the precipitation of calcium oxalate? C. A. Underwood.

At all convention sessions and social functions, the ladies will have a most cordial welcome, and the local committee has arranged special entertainment for them.

There will be a reception and tea from 4 to 5:30 p.m. Monday, to which the gentlemen are invited. Luncheon at Heinz's on Tuesday will be followed by inspection of this famous plant. A luncheon and theater party will be given on Wednesday.

"Methanol" Officially Adopted for Alcohol Nomenclature

At a recent meeting of the board of governors of the National Wood Chemical Association, a resolution was adopted recommending the universal adoption of the designation "crude methanol" or "refined methanol" in place of the term "wood alcohol." The recommendation, which was broadcast to members of the association, follows:

> The large number of casualties due to drinking liquor containing wood alcohol has for many years directed attention to the necessity of adopting some measures that would remove the danger to human life and surround the use of this product with a greater degree of safety.
>
> One of the most advanced steps in this direction was taken when the American Chemical Society suggested the use of a word which did not contain the word "alcohol" and that the term "methanol" be employed. This term has since been used extensively by many large manufacturers, also by the Forest products Laboratory, the United States Tariff Commission, the Mellon Institute of Industrial Research, and others.
>
> Our association has given the matter due consideration and at a recent meeting of the board of governors adopted a resolution recommending that the term "wood alcohol" be discontinued and the term "crude methanol" or "refined methanol" used hereafter as the case might be. Railroad companies will be requested to make such changes in their classifications and tariffs as they may consider necessary to apply the same rates on shipments of "methanol" as are now published on shipments of wood alcohol, and your co-operation in effecting this change will do much toward accomplishing the desired result.

It is felt that this industrial endorsement of the chemists' recommendation marks a worth while decision.

Eastern Potash Corporation in Hands of Receiver

The Federal Court, New Jersey, has appointed custodial receivers for the Eastern Potash Corporation of New York, in the persons of James Kerney, Trenton, and Joseph H. Quigg, Newark. The company has an authorized capital of $7,500,000, and for some months past has been building a large plant in the Raritan River section of the state, for the manufacture of potash, chemicals and byproducts, utilizing local green sands and marl for raw materials. The new works are said to be practically completed, but have never been placed in operation. The liabilities of the company are stated as $3,000,000, and assets of approximately $1,000,000 in excess of this amount, without available cash. The corporation also owns a controlling interest in the Raritan Refining Co., with plant on the Raritan River, Raritan Township, N. J., and the Eastern Limestone Corporation, with works at McAfee, N. J.

Business Paper Editors Visit Capitol

Hear Durgin on Simplified Practice and Hoover on European Conditions

The National Conference of Business Paper Editors met in Washington on Jan. 15 for the purpose of conferring with Secretary Hoover, visiting the United States Bureau of Standards and conferring with the officials of the Chamber of Commerce of the U. S.

At the offices of the Chamber of Commerce the subjects discussed were the present status of the ship subsidy, the Chamber's referendum on education, and the effect on trade associations of the recent consent decree in the case of the United States vs. Gypsum Industries Association.

Simplified Practice

At the Bureau of Standards the members of the Conference were luncheon guests of the technical staff, later visiting the laboratories. One of the features of the afternoon was an illustrated lecture on simplified practice by William A. Durgin, head of the division devoted to that subject.

"Many of our industries—many more of our businesses—believe that we are suffering from too great variety in almost every article of commerce in this country," he said. "Leading men in widely different fields agree that the reduction of variety, the simplifying of industrial and commercial practice in any line, will secure some or all of these advantages:

"Simplified practice will decrease stocks, production costs, selling expenses, misunderstandings and all costs to user.

"Simultaneously, simplified practice will increase turnover, stability of employment, promptness of delivery, foreign commerce, quality of product, profit to producer, distributor and user."

Secretary Hoover has established the Division of Simplified Practice to serve as a centralizing agency in bringing producers, distributors and users together and to support the recommendations of these interests when they shall mutually agree upon simplifications of benefit to all concerned. Any group in any branch—production, distribution or use—can secure the services of the division upon request.

Hoover on Economic Problems

In the evening the Conference met with Secretary Hoover in the cabinet room in the Willard Hotel and listened to an instructive discussion of domestic and foreign economic and industrial topics of the day.

Industry and commerce in Europe have been hit on the head with a mallet as a result of the French seizure of the Ruhr Valley. It has sent a shiver down America's commercial spine, but it carries no threat of a financial catastrophe. In fact the Franco-German relations constitute the only really sore spot on the world's body politic. Sterling is nearly at par. Italy is showing great progress as are most of the other countries of Europe. Even Russia is improving fundamentally.

The effect of France's action will be felt most in America by the producers of small grains. Our manufacturing industries will not be affected greatly. As a matter of fact, it may stimulate the buying of our products by foreigners, since the drastic action of the French gives rise to some fear that the disturbance may become more general, thereby interfering with deliveries. This may cause buyers abroad to place orders immediately, which otherwise might not go forward for many months.

The situation also tends to accentuate that each nation lost the war from a material point of view. The French are the only ones who have refused to admit that fact. Europe, however, is in a much better position now to stand the shock of the French policy than it would have been a year ago. Great progress has been made throughout Europe, with the exception of France, Germany and Austria, in the matter of social, political and economic stability. The improvement in England is particularly marked and unemployment is 30 per cent less than a year ago.

Important Hydro-Electric Development Under Way in Canada

The pulp and paper interests of Canada have been aroused by the important announcement that a dam is to be built at the Grande Discharge from Lake St. John, Quebec, the headwaters of the Saguenay River, which will ultimately develop a million horse power, and will mark another step toward the realization of a dream on the part of certain Quebec politicians, that the province will eventually be lighted and heated electrically.

The contracts between the Provincial Government and the Quebec Development Co. providing for the carrying out of the project have been signed. The cost of the construction according to expert estimates will reach over $12,000,000. Price Brothers, who are at present increasing the capacity of their pulp mills, have guaranteed to buy $1,600,000 worth of power per year.

Public Meeting Planned in Honor of Pasteur

The evening of Jan. 28 will be devoted to exercises in honor of Louis Pasteur at the Town Hall, New York City. Chemical and medical societies have already held memorial meetings in commemoration of the hundredth anniversary of the birth of the French scientist, but this open meeting is planned especially for the general public. Ambassador Jusserand of France will preside and three or four brief addresses will be made by prominent educators and officials dealing with Pasteur's many activities. No charge will be made for the tickets of admission and they will be sent to the various contributors and societies for distribution.

Explains German Connection of New Potash Firm

Representative States That German Interests Are Not Backing Potash Importing Corporation

German interests are not backing the newly formed Potash Importing Corporation of America, according to an official statement of the company given to the New York *Times* on Jan. 18. The statement said that "neither the German Potash Syndicate nor any other German interests has stock in the Potash Importing Corporation of America; neither can they in any way influence the policy of the new corporation."

A. Vogel, American representative of the German Potash Syndicate, said:

"It has been stated that the German Potash Syndicate was anxious to conclude an agreement with an American corporation in order to avoid taxation at home and that Germany would be seeking another loophole to avoid reparations payments, as it is believed that payments for German potash will be allowed to accumulate in this country. The new agreement does not in any way change the liability of the syndicate to pay its German taxes, nor does the syndicate intend to accumulate dollar accounts in this country on account of the reparations matter, because the syndicate is in no wise involved in the reparations question.

"The chief reason for the syndicate entering into an agreement with the Potash Importing Corporation of America is the fact that I notified the syndicate more than a year ago that I would wish to retire within a reasonable time and that it would be necessary for the syndicate to look out for a successor, preferably in the form of an American corporation. The syndicate, therefore, accepted an offer of the Potash Importing Corporation of America to market and distribute the syndicate's products in the United States from May 1, 1923."

"Radium" Company Cited for Fraudulent Advertising

Advertisements by the Aaban Radium Company, Chicago, Ill., that a product manufactured by it contained radium is the basis of a citation just issued by the Federal Trade Commission.

Based upon a preliminary inquiry, the Federal Trade Commission has reason to believe that this firm's product contains no radio-active material and that its advertisements to that effect are deceptive.

Messrs. Abbott E. Kay and R. T. Nelson, co-partners trading as the Aaban Radium Company, are named in the citation and have been called upon to file an answer and appear at a hearing to be conducted by the Commission. At this hearing witnesses representing both sides will be examined to determine the truth or falsity of the firm's advertisements and thereafter a decision will be reached by the Commission.

Coal Commission Report Disappointing

Brings Out No New Data or Explanation of Price Spread Between Mine and Consumer

In its effort to be absolutely fair and to avoid placing responsibility before the blame is proved, the President's Coal Commission has brought out a report which is certain to be a disappointment to the consumers of coal and to many members of Congress. In the coal trade itself there is a very evident sense of relief. In the average investigation of this kind, it is customary to have some harsh things to say to operators, wholesalers and retailers, even before it has been established that they are guilty.

The Jan. 15 report has all the indications of a desire to avoid expressing conclusions until all the facts can be weighed. As a consequence, it may be predicted that the smaller consumers and a certain element in Congress will feel that the report is colorless and that the commission is not reaching the seat of the trouble. It does not express an opinion as to whether or not current prices are just. It does not say whether or not the miners are receiving a higher rate of wage than the consumers should be called upon to pay. No one is accused of profiteering. The report indicates in a general way something as to the spread between the cost at the mine and the delivery cost of coal, but it gives no clue as to who is responsible. Labor, transportation, over-development, storage and other matters are discussed, but little is said about the business factors in coal. For that reason it is certain that some of the gentlemen on Capitol Hill will conclude that the commission has written "Hamlet" with *Hamlet* left out.

Little New Data in Report

The more constructive thinkers both within and without the industry seem to be agreed that the commission did well in making haste slowly. Even those who are expressing much disappointment with the report are inclined to suspend final judgment as to the possibility of the commission bringing out something concrete at a later date.

A careful analysis of the report shows that there is little material in it which could not have been written on the first day that the commission sat. Nevertheless the presentation of this material is regarded as very valuable because the wide publicity will contribute greatly to the popular understanding of the entire subject. The report must be regarded more as a statement of the problems of the commission than as a contribution to their final solution. Not the shred of new statistical information is contained in the document. From a constructive point of view, this failure is regarded as the most serious because the report as it stands holds out no assistance to the New York conference. An unusual opportunity was offered to get material of a statistical character before that body, but this seems to have been made impossible by the mix-up over the cost forms.

A significant feature of the report is the indication that the commission is not inclined to allow the industry to blame all of its ills on slowness of transportation.

Employees of Commission

In connection with its denial of charges that political patronage is being handed out in the way of clerical positions the commission has issued a personnel statement giving the exact numbers of its employees in the various classifications. It follows:

"The commission's staff as at present constituted includes fifty-six technical employees and ninety-three non-technical employees. The members of the technical staff include: Four engineers, thirty-eight investigators, six assistant investigators, seven examiners, one mineral geographer.

"The non-technical employees include: One secretary, one chief clerk and disbursing officer, one administrative assistant, one confidential clerk, forty statistical clerks, eleven stenographers, eight typists, two comptometer operators, seven clerks, three calculating machine operators, one statistical draftsman, six operatives, one graphotype operator, two file clerks, three apprentices and five messengers.

"No member of the commission has a private secretary or messenger."

Export Statistics to Be Compiled in New York

After a careful study of the manner in which import and export statistics are being collected, Commerce Secretary Hoover has decided to continue to compile those figures in New York. Legislative authority recently was given which enabled the transfer of this statistical work from the Treasury to the Commerce Department. The same law authorized the Secretary of Commerce to consolidate the Bureau of Commerce statistics in New York with the Bureau of Foreign and Domestic Commerce and to transfer the work wholly or in part to Washington.

Since import and export figures must be handled largely during a comparatively few days of the month, the impression long has prevailed that if the work were transferred to the Bureau of the Census in Washington, a large number of employees could be temporarily released from their regular duties to handle that peak. The survey of the situation, however, developed that the work is expedited in New York by the fact that the statistical force has close contact with the collector's office in the New York Custom House.

Figures covering the imports during the last nine days of September and during the month of October are becoming available only at this time. This long delay has been occasioned by the changes of schedules caused by the enactment of a new tariff act and by certain other changes in the classifications.

Rubber Planters Confer With Manufacturers

British Representatives Meet With American Manufacturers in Attempt to Assure Future Supplies

British rubber planters and American rubber manufacturers held meetings in New York last week, for the purpose of seeking some way of adjusting the rubber situation so that a price level equitable to both groups may be arranged.

The British planters, Sir Stanley Bois, Eric P. Miller and B. J. Burgess, represent the Rubber Association of London, a group of planters controlling 70 per cent of the world's rubber supply. The American manufacturers represent the Rubber Association of America, whose membership is responsible for 70 per cent of the world's rubber consumption.

The American committee is made up of H. Stewart Hotchkiss, vice-president of the United States Rubber Co.; B. G. Work, president of the B. F. Goodrich Co.; William O'Neill, of the General Tire & Rubber Co.; C. W. Litchfield, of the Goodyear Tire & Rubber Co.; F. H. Brown, of Meyer & Brown, Inc.; William B. Pfeiffer, of the Miller Rubber Co., and Horace De Lisser, of the Ajax Rubber Co.

Washington Interested

The Department of Commerce is said to be interested in what the present conference may do. Assistant Secretary of Commerce Houston conferred with the British party Thursday night and returned to Washington.

The work of the conference, which met in the rooms of the Rubber Association in the Fisk Building, New York, began with an exposition to the visitors of the conditions surrounding the rubber manufacturing industry in this country. In their turn the British committee put before the American manufacturers a thorough outline of the situation in England and its colonies.

Complaint Against Jobber Posing as Manufacturer

Whether or not a jobber and wholesaler may rightfully advertise as a manufacturer is the question involved in a complaint issued by the Federal Trade Commission against the American Turpentine Co., a concern trading as the North American Fibre Products Co.

According to the complaint, the Amercan Turpentine Co. is a jobber and wholesaler of paints, varnishes and similiar products, with its principal office in Cleveland, Ohio. The company, it is alleged, resells its commodities under the name of the North American Fibre Products Co., and in the sale thereof advertises that such commodities are manufactured by the company so selling them.

The commission contends that this practice is an unfair method of competition, as it leads the public to believe that the respondent's products are purchased direct from the manufacturer, thereby saving all intermediate profits.

Courses in Cereal Chemistry at Minnesota University

During the first week in January, twenty-four men and women interested in cereal chemistry gathered together for a week of intensive study of wheat and wheat products. The work was given at the University of Minnesota and was in charge of C. H. Bailey. The morning sessions were devoted to lectures and the afternoons to laboratory work.

Dr. Bailey had charge of the work on hydrogen-ion determinations; R. A. Gortner discussed "Colloids and Proteins"; L. S. Palmer, "Wheat in Nutrition"; J. J. Willaman, "Enzymes in Fermentation"; H. K. Hayes, "Wheat Breeding"; E. O. Stakman, "Wheat Diseases"; R. N. Chapman "Wheat and Flour Insect Pests" and A. C. Arny, "Wheat Classification."

The afternoon sessions were devoted to: Viscosity measurements of flour, using the MacMichael viscosimeter; hydrogen-ion determinations of flour; hydrogen-ion determinations of fermenting dough; electrical conductivity measurements of flour.

Applicants for the course were many times the number accepted. The latter were necessarily limited because of lack of laboratory facilities to handle a larger number. This large demand for intensive training is conclusive evidence of the great desire on the part of cereal chemists for fuller information in this particular field of cereal chemistry. Certainly such a course as here outlined could not be better given than at the University of Minnesota, for nowhere, either in the United States or abroad, is more intensive work or more capable research work being done than at this university. The names of Dr. Gortner and Dr. Bailey are at the top of the list of those who are applying the most advanced methods of physical and colloidal chemistry to the solution of fundamental flour and baking problems.

Scientific Control in Baking

The physical properties of wheat flour seem to revolve largely around the colloid properties of its gluten. The capacity of the gluten to absorb water and to vary largely in its viscosity depend on the hydrogen-ion content of the medium in which it finds itself. This hydrogen-ion content is affected to a greater or less extent by the buffer action of the salts present, notably the phosphates. These buffer effects vary with the wheat flour grade.

Fermentation, so necessary for the production of bread, is an enzymatic process, and the speed with which a fermenting dough reaches the point where it is ready for the oven is largely a function of intensity of the acidity of such dough.

In some of the largest bakeries of this country, the dough fermentation period is under scientific control by following the change in p_H as the fermentation proceeds. When the proper p_H has developed the dough is placed in the oven.

Paper Plant Expansion Keeps Pace With Water-Power Development

As a result of the negotiations recently concluded between the provincial government of Quebec and the new company organized to develop the power resources of Lake St. John and the Saguenay River already in its initial stages, announcement was made at the offices of the Canadian Export Paper Co., Ltd., that Price Brothers & Co., Ltd., for which it acts as export selling distributor, has entered upon a 3-year program of expansion which will ultimately increase its present daily output capacity of 300 to 900 tons of paper, or 280,000 tons a year, thereby setting a new record for Canada.

The initial work of installation is already under way and the program calls for the production of 200 tons a day new output by January, 1924, and 200 tons additional at the beginning of each of the two succeeding years until the maximum is reached. Price Bros. & Co., Ltd., owns or controls about 9,000 square miles of freehold and leasehold timber limits in the valley of the Saguenay River and the Lower St. Lawrence which have been roughly estimated to contain 20,000,000 cords of pulp wood.

Wide Interest Evidenced in Paper Exposition

In the Paper Industries Exposition to be held during the week, April 9 to 14, at Grand Central Palace, New York, while the American Paper and Pulp Association and its related associations are meeting, three main groups will feature the list of exhibits. The first group will cover paper-making machinery and the chemicals entering into the manufacture of paper; the second will be the making of paper itself, and the third the conversion of paper into its various subdivisions in which it reaches the public, such as boxes, twine, and specialties, as well as the large field of distribution to printer and consumer in the form of writing paper and other papers.

The manufacturers of paper mill supplies have been prompt to take advantage of this opportunity to present their equipment to the paper mill executives who will be at the exposition. A large attendance of paper manufacturers and merchants during the week is likely because of the fact that the exposition will be held during the week of the annual conventions of American Paper and Pulp and the National Paper Trade Associations and their affiliated organizations. The manufacturers of beaters, rolls and other similar heavy equipment are already well represented among the exhibitors as are also the chemical supply companies, which sell bleach, colors, and all of the wide range of chemicals entering into the manufacture of paper. The manufacturers of specialties, such as boxes, paper, twine and the like, are included among those who have contracted for exhibit space.

The chief efforts of the exposition management, however, have at the outset been devoted to the securing of educational exhibits for the show. The Forest Products Laboratory, of Madison, Wis., and the Research Laboratory of the United States Forest Service have been invited to present an exhibit. An effort, for instance, is being made to have a special exhibit of the United States Bureau of Standards, which operates its own paper mill at the laboratory in Washington, where tests are made of paper made by different processes from miscellaneous materials.

Plan Complete Study of Fastness of Dyes

Experiments to determine the effects of various dyestuffs upon different textiles are to be undertaken in the near future by the United States Bureau of Standards. Fastness in relation to moisture and light, oxidation and chemical changes under varying conditions are to be studied especially. The experiments will continue some months.

Exporters of textiles in particular are interested in a number of problems regarding the dyes put into their goods which have arisen, accumulating over a course of years. It has been found that a dye which is satisfactory for the domestic trade sometimes fails to maintain its quality on exported fabrics. The Bureau of Standards has been asked to determine the degree of washing advisable under different conditions; the varying quality and quantity of dyestuff necessary to hold successfully in different mixtures of yarns; to study the problem of fading in mixed colors and generally cover the subject.

It is expected that several trade associations of textile manufacturers will contribute to a fund with which the bureau may carry forward these experiments on a scale larger than that which would be possible with the limited appropriation at its disposal.

Selenium Chloride Used for Activating Carbon

A new and improved method of making a superior grade of purified carbon at moderate cost has been recently invented by Prof. Victor Lenher of the chemistry department of the University of Wisconsin, and patented jointly with the General Electric Co.

The material yielded by the process may be used for various purposes, such as an activated carbon in gas masks, or in the recovery of gasoline from natural gas. As a purifier material it may be employed in the manufacture of dry-cell batteries or for electrodes.

The new process consists of treating charcoal with selenium oxychloride, a solvent for the hydrocarbons, removing the solution, and washing the residue. The product of such a treatment is much purer than the product of other methods, it is said, and possesses great absorptive properties, and may be used more effectively than ordinary activated charcoal for the absorption of gases. Relatively moderate temperatures below 100 deg. C. are used.

New Jersey Chemists Hear Chamot and Herty

Record Attendance Attracted by Highly Practical Topic, "How Shall the Chemist Live?"

"Solving Problems by Means of the Microscope" and "How Shall the Chemist Live?" were the subjects discussed at the January meeting of the New Jersey Chemical Society, at the largest gathering ever held by that organization. Prof. E. M. Chamot of Cornell University, and president of the Technical Photographic and Microscopical Society, recommended the microscope as a short-cut for chemical research. Recourse to that instrument, he declared, will save both time and money, particularly in "solving those problems which arise in that no-man's land lying between physics and chemistry and physics and the biological sciences. By means of some excellent slides, Dr. Chamot demonstrated the advantages of the microscope in examining such things as ancient coins, glazes on porcelain, textiles and furs. It was interesting to note that in the two last named cases, the microscope shows marked difference in the structure of mulberry silk from the domesticated silk worm, wild silk and artificial silk. The characteristic properties of most animal hairs serve as a quick and easy method of determining the sort and nature of any furs.

How Shall the Chemist Live?

It was Dr. Charles H. Herty's discussion of the economic status of the chemist, however, that most strongly appealed to the New Jersey chemical workers. Anything that affects the chemical industry, Dr. Herty declared, is bound to have its reaction on the chemical profession of this country. Therefore, the policy of short-sighted executives who have abandoned industrial research can only be regarded as a serious blow to the chemist. After reviewing the various lines of activity open to the chemist in both academic and industrial work, Dr. Herty called attention to the special appeal offered by the synthetic organic chemical industry. Here is an industry with a greater proportion of output per chemist than in any other branch of industry. The greatest enhancement per unit of raw material is directly attributable to the work of the chemist.

American Chemists Should Lead

Dr. Herty warned the leaders in the field of synthetic organic chemistry against being satisfied with simply doing as well as another nation has already done. "This country," he said, "has the right to expect that American chemists, if given the chance, will lead the world in the development of chemical industries, but this can only be accomplished by research work of the highest type by men who dare venture into untrodden fields." Very aptly Dr. Herty applied to the chemical industry that biological truth—"when growth stops, decay sets in." He showed clearly by means of employment figures taken from the Tariff Commission's Census of Dyes and Organic Chemicals that the chemist is keeping pace with his industry. In 1920, 2,406 chemists were employed in the synthetic organic chemical industry to produce 370,000,000 lb. of products. In 1921, 1,561 chemists in this same industry produced but 121,000,000 lb. of products.

In concluding his talk, Dr. Herty called attention to unsound public opinion regarding the chemical industry. He attributed much of this to the chemists' failure to keep the public properly informed. "We have no right," Dr. Herty said, "to keep the laymen in ignorance of what we are doing, and I should like nothing better than to see New Jersey, as the center of the chemical industry of the country, take the lead in helping the people to know what chemistry has to offer."

Make Byproducts Pay to Eliminate Waste

An important step forward in the campaign looking to the elimination of waste in industry is about to be made, Secretary Hoover has intimated. Plans are practically complete for a survey of the lumber industry with the idea of developing the wastes which can be eliminated profitably.

Waste cannot be eliminated, to any important extent, by legislation. If it is to be prevented, it must be made profitable. The contemplated investigation will be made under a co-operative agreement between the Department of Commerce and the lumber industry. It is believed that a systematic and nation-wide study of wastes, by industries, will reveal great opportunities for the utilization of byproducts.

Personal

Thomas M. Bains, Jr., of California has been appointed assistant professor of mining engineering, University of Illinois, Urbana. He will have charge of the coal-washing and ore-dressing laboratory.

H. C. Barlow, formerly of the chemical and metallurgical branch of the Dominion Bureau of Statistics, has returned to his former position as assistant chemist for the Deloro Smelting & Refining Co., Deloro, Ont., having resigned from the bureau.

Robert Gilman Brown has been elected president of the Institution of Mining and Metallurgy, 1923-1924, to succeed S. J. Speak.

Arthur P. Denton has resigned as sales manager, Pacific Portland Cement Co., to become district engineer for the Portland Cement Association, with headquarters at the San Francisco office.

T. A. Dines has been chosen president of the Midwest Refining Co., Denver, to succeed Henry M. Blackmer, who has been made chairman of the board. Mr. Blackmer will continue his active association with the company, leaving the details of the administration of its affairs to Mr. Dines. Mr. Dines has been connected with the Midwest company since 1915, when he was elected treasurer.

Walter F. Graham, who for some time past has been associated with the Henry Souther Engineering Corporation in Hartford, Conn., has resigned to take charge of the foundry operations of the Curtis Bay Ship & Engine Co., Baltimore, Md.

Herbert R. Hanley, formerly of Bakersfield, Calif., has accepted the position of associate professor of metallurgy at the Missouri School of Mines, Rolla, Mo.

Colonel George T. Slade has been elected president of the Tide Water Oil Co., New York, succeeding Robert B. Benson, who has become chairman of the board.

Dr. Julius Stieglitz, director of the department of chemistry, University of Chicago, spoke before the Philadelphia Section of the A.C.S., Jan. 18, on "The Laws of Chemistry Govern the Mechanism of Life."

Robert E. Swain, professor of chemistry at Leland Stanford University, sailed for Europe on Jan. 18. He expects to be gone about 6 months and will visit various countries of continental Europe.

James G. Vail, of the Philadelphia Quartz Co., presented a paper on "Uses of Sodium Silicate" before the Association of Corrugated Paper and Fiber Box Manufacturers, New York City, Jan. 18.

The following men from the University of Chicago will give talks by radio from the Chicago *Daily News* station: Feb. 20, Prof. Julius Stieglitz, on "Chemistry and Medicine"; Feb. 27, Prof. H. I. Schlesinger, on "Radioactivity," and March 6, Prof W. D. Harkins, on "The Structure of Atoms."

The following officers have been elected for the Southeast Texas Section of the A.C.S. for the year 1923: President, L. S. Bushnell; vice-president, W. A. Slater; councilor, F. M. Seibert; treasurer, L. B. Howell, and secretary, P. S. Tilson.

Obituary

Albert H. Miller, chief metallurgist of the Nicetown works of the Midvale Steel & Ordnance Co. and an expert in steel analysis, died Jan. 11, at Ambler, Pa. He was 43 years old. Mr. Miller was a graduate of the University of Pennsylvania and entered the employ of the Midvale company in 1901.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

The Present Trend of Business

Return of Confidence, Higher Prices, Easier Money Conditions and Growing Volume of Manufacture Form Basis of Favorable Prediction*

BY PERCY H. JOHNSTON
President, Chemical National Bank of New York

AN ANALYSIS of the present situation reveals indications that business has entered a period of increased activity and that an appreciation of values in the commodity markets is under way. The fact that confidence in future values has been largely restored is evidenced by the pronounced rise in the price level which has occurred in the past few months in contrast to a continued decline during the preceding year and a half. While difficulties in handling the increased freight traffic by the transportation system have become an important factor in the current industrial situation, yet the railroads are dealing efficiently with the problem and it is not thought that the ill effects of congestion will be more than transitory.

More serious, indeed, is the possible shortage of labor and a resultant rise in the wage scale. It is of significance that in England, with whose products we must compete in the markets of the world, no correspondingly definite rise in commodity prices has yet occurred and instead of an increase in the wage scale, recent reductions have been reported. In fact there is in England considerable unemployment.

INCREASED PURCHASING POWER

Of the forces at work tending to bring about an increased volume of business and higher prices the most important is the enormous supply of credit available for industry and commerce, due primarily to an unprecedented amount of gold at present in the country. The increased cost of production of articles of manufacture, due to a higher wage scale and the enhanced value of raw materials, tends to raise the price of the finished product. Other forces which will tend to effect a rise in commodity values are the increased purchasing power of the wage-earner; the recent tariff law, which increases the price of importations of both raw materials and manufactured products; and finally the speculation which invariably accompanies easy money conditions and a rising commodity market. Increased volume of trading will be accentuated both by the fact that inventories have been well liquidated, and that the ultimate consumer who has deliberately, during the period of falling prices, postponed purchases not of an absolutely necessary nature, will immediately supply his accumulated needs when he is convinced that the market is rising.

EUROPE'S PROBLEM

It is, however, futile for us to look for the return of full prosperity in America until the re-establishment of war-torn Europe on a sound economic basis. America cannot have continued prosperity while Europe is at the same time prostrate. The question of an economic readjustment cannot and will not take place until the matter of reparations is definitely concluded and its faithful performance is undertaken in the right spirit. This is Europe's job and must be solved by Europe before the rest of the world can sit at the council table and work out a general plan for stabilization and the re-establishment of sound commercial intercourse between nations.

PROSPECTS FOR 1923

Although it is beyond the ability of any man to forecast what the year 1923 holds in store, yet it is our conclusion that American business has definitely emerged from a state of depression and has progressed into a constructive period of recovery.

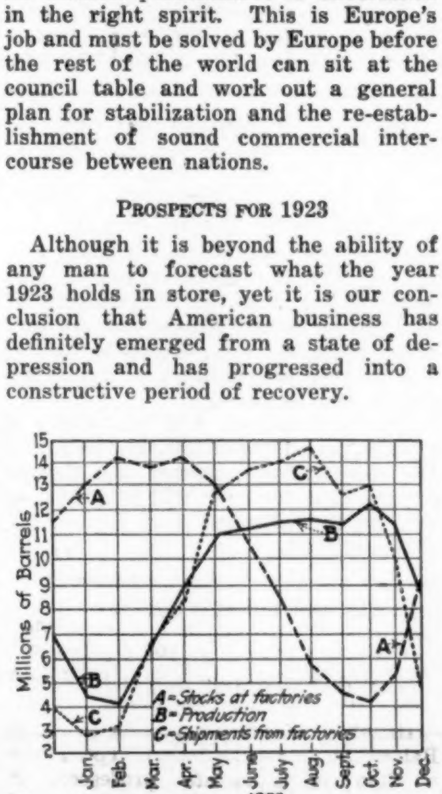
*Extracts from the president's report to the stockholders, Jan. 9, 1923.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	174.21
Last week	171.71
January, 1922	144
January, 1921	181
January, 1920	242
April, 1918 (high)	286
April, 1921 (low)	140

A marked rise in this week's index number results from the considerably higher prices for both cottonseed and linseed oils. Slightly lower quotations on caustic soda did not affect the index appreciably.



MONTHLY FLUCTUATION IN CEMENT PRODUCTION, STOCKS AND SHIPMENTS

Record Shipments of Cement Made in 1922

Both Output and Shipments Show Marked Gains Over 1921, According to Geological Survey Figures

During the year just ended the output of finished portland cement is estimated to have reached 113,870,000 bbl., as compared with 98,293,000 bbl. in 1921, a gain of 16 per cent. These figures, which are those of the U. S. Geological survey, are based on actual returns from producers, although lack of reports from four producers made it necessary to estimate figures in their cases.

A total of 116,563,000 bbl. of cement was shipped to consumers throughout the United States during 1922. This represents the heaviest total of shipments recorded in the history of the industry. Shipments during 1921 reached 95,051,000 bbl., or a little over three-quarters of the total for the year just passed.

CEMENT PRODUCTION SHIPMENTS AND STOCKS

	1921 No. of bbl.	1922 No. of bbl.
Production	98,293,000	113,870,000
Shipments	95,051,000	116,563,000
Stocks on hand at end of year	11,938,000	9,134,000

Stocks of finished portland cement at factories, Dec. 31, 1922, amounted to 9,134,000 bbl., or 2,804,000 under the quantity on hand one year ago.

There were also about 2,823,000 bbl. of clinker, or unground cement, at the mills at the end of December, as against 1,949,000 bbl. at the beginning of the month.

As shown in the accompanying table, stocks on hand Dec. 31, 1922, were not only lower than those available Dec. 31, 1921, but shipments exceeded production by nearly 3,000,000 barrels.

Stabilizing Influence Seen in New York Chemical Market

Manufacturers Advance Prices on Acetate of Lead and Hydrofluoric Acid—Potassium Salts Show Strength on Spot

ACTIVITY in the chemical market has been limited to a few special items during the past week and trading in general was of a routine nature. Prices for most chemicals held to their former levels, with a few increases noted, due, it was said, to increased producing costs. The chemical market in general seems to be quite slow in hitting the new year stride and several leading interests are expressing their disappointment at this condition. It is generally believed, however, that the gradual recovery will lead to a completely stabilized market which will show satisfactory results in the long run.

Dealers in arsenic were inclined to offer spot goods at lower prices. Several fair-sized tonnages were reported on dock from Japan. It should be pointed out, however, that the market still retains a very strong position and any pronounced buying activity will tend sharply to advance spot quotations. Producers of acetate of lead announced an increase of 1c. per lb. for all grades. The recent rise in the metal is directly accountable for the new price. Caustic potash is quite firm on the spot market, due to the difficulty experienced in obtaining foreign shipments. Caustic soda for export was a shade easier, although the domestic inquiry continued fairly active. The bichromates showed a slight tendency to strengthen on the spot market and dealers were not anxious to offer any round lots at inside figures. Ammonium nitrate was in very strong demand, with spot stocks completely exhausted. Fluoride of soda, acetate and chlorate of soda, formaldehyde and oxalic acid continued along moderate lines with demand merely of a routine nature.

Principal Price Changes

Acetate of Lead — Producers announced an increase of 1c. per lb. on all grades due to the increase in lead prices. Quotations for white crystals range around 13@13½c. per lb. Demand is quite active.

Acetate of Soda—Several sales were recorded around 6½c. per lb. The general range, however, is around 6¾@7c. A few stressed lots were noted on the spot market and these had a strong tendency to weaken quotations.

Arsenic — Several large shipments from Japan weakened the spot market and jobbers were quite willing to accept business at 15¼c. per lb. Buyers showed no anxiety to pay top figures and actual trading was of a limited nature. The range was around 15¼@15½c.

Bichromate of Soda—Small lot trading seemed to feature this market and prices ranged around 7¾@8c. per lb. Round lots were offered down to 7½c.

Bleaching Powder — Producers continue to quote 2c. per lb. for large drums, f.o.b. works in carload lots. Spot goods all in limited supply and dealers quote $2.25 per 100 lb. for odd lots. The demand continues along very active lines.

Carbonate of Potash — A moderate improvement was reported in the calcined and hydrated grades. Offerings were not as plentiful as noted during the past few weeks and inward manifests seem to have decreased considerably. Calcined 80-85 per cent is now quoted at 5¾@6c. per lb. with hydrated at 7c. per lb.

Caustic Potash—Imported 88-92 per cent is reported higher on spot at 7c. per lb. The strong position of the foreign market is keeping prices unusually high. Consuming inquiry continues moderately active.

Caustic Soda—Slightly lower prices for export were announced due to the lack of buying interest. Spot quotations range around $3.45@$3.50 per 100 lb. f.a.s. Domestic inquiry is quite active with contracts quoted at $2.50 per 100 lb., basis 60 per cent f.o.b. works in carload lots.

Chlorate of Soda—Demand continues along routine lines, with domestic makers quoting around 6½@6¾c. per lb. Imported material is being held at the same level.

Cyanide of Soda — Domestic producers continue to quote 23c. per lb for 96-98 per cent goods and report a fair consuming business. Imported material ranges around 19@22c. per lb., according to strength and quantity.

Fluoride of Soda—Activity has been quite limited during the week and prices for imported goods were lower at 9@9¼c. per lb. Domestic prices ranged around 10@10½c. per lb.

Formaldehyde—Producers continued to quote 16c. per lb. for carload lots and 16½c. for smaller quantities. Demand is somewhat easier due to several second hand offerings around 15¾c. per lb.

Oxalic Acid—Domestic material on spot ranges around 13c. per lb. with imported held at 13¼@13½c. duty paid. Demand has been quite active of late.

Soda Ash—Domestic business was reported quite satisfactory with several carlot transactions at $1.75 per 100 lb. in single bags. Contract business was reported in fair demand at $1.20 per 100 lb., f.o.b. works, basis 48 per cent, single bags, carload quantities.

Linseed Oil—Prices for spot goods were advanced 3c. per gal., due to the higher seed market. Oil in carload quantities, cooperage basis, sold around 90c. per gal. for immediate delivery.

Paint and Varnish Industry in 1921 and 1922

Census Figures for January-June, 1922, Are 1.5 to 50.5 Per Cent More Than in 1921

The first semi-annual statistics of paint and varnish production taken at the request of the industry by the Census Bureau show a marked expansion of these industries during the first half of 1922, thus confirming forecasts made at the November convention of the National Oil, Paint and Varnish Association. The report covers the output in the first 6 months, Jan. 1 to June 30, 1922, with comparisons for the calendar years of 1920 and 1921. The accompanying tabular statement presents the statistics:

The data were compiled from reports from 402 establishments, of which 104 reported the manufacture of white lead in oil; 120 the manufacture of zinc oxide in oil; 228 the manufacture of other paste paints; 337 the manufacture of ready mixed and semipaste paints; and 246 the manufacture of varnishes, japans and lacquers.

The next report will cover the 6 months period ended Dec. 31, 1922, and for comparative purposes the figures for the calendar year will be given, as well as the calendar year figures for 1921 and 1920.

PRODUCTION OF PAINTS AND VARNISHES, 1920, 1921 AND 1922

	1922 Jan. 1 to June 30 (6 months) Lb.	1921 (Full Year) Lb.	1920 (Full Year) Lb.	Per Cent of Increase* 1921-1922†	Per Cent of Increase* 1920-1921
Paints:					
Paste paints	207,469,000	382,490,000	343,626,000	8.5	11.3
White lead in oil	138,942,000	273,874,000	209,372,000	1.5	30.8
Zinc oxide in oil	4,341,000	5,770,000	7,946,000	50.5	—27.4
Other paste paints	64,186,000	102,846,000	126,308,000	24.8	—18.6
Ready mixed and semi-paste, including wall paints, "mill whites," and enamels	Gal. 31,159,000	Gal. 44,500,000	Gal. 55,248,000	40.0	—19.5
Varnishes, Japans, and lacquers	24,998,000	34,316,000	49,594,000	45.7	—30.8

* A minus sign (—) denotes decrease. † Increase with respect to one-half of 1921.

23,260 for a Dollar

German marks as a medium of international exchange almost dropped off the market Jan. 18 when cable transfers on Berlin fell to $0.000043. This is a new low record, equivalent to 23,260 marks to the American dollar.

The note circulation of the Reichsbank at the end of December, 1922, amounted to 1,200,000,000,000 marks, compared with 754,000,000,000 marks at the beginning of December and 469,000,000,000 at the beginning of November.

Better Volume of Business in Chicago Market

Price Tendency Generally Upward With Fairly Active Trading

CHICAGO, Jan. 18, 1923.

A very good volume of business was reported from practically all divisions of the industrial chemical market. Spot goods were moving well and withdrawals on contracts were quite heavy. Prices held firm, particularly on imported material, where the uncertainty of replacements strengthened the market. The tendency all along the line was upward; buyers apparently realized it and were taking on supplies beyond their immediate requirements.

PRICES WELL MAINTAINED

Alkalis were well maintained in price and were reported as moving in a good volume in the spot market. The ground 76 per cent *caustic soda* was quoted in moderate lots at $4.25 per 100 lb. and the solid at $3.50. *Caustic potash* was sharply advanced in the spot market and 8c. per lb. on the 88-92 per cent material was the best offer noted. This advance was not surprising, as the spot price on caustic potash has been below the import cost for some time past. *Soda ash* was in good demand and the price was steady at $2.25 per 100 lb. basis cooperage.

Potash alum was in fair request and only moderate supplies were available for spot delivery. The iron-free lump was quoted in single cask lots at 4½@5c. per lb. and the powder in similar quantities at 5½@6c. per lb. *Ammonium chloride*, white granular, was in good demand, with the spot price firm at 8@8½c. per lb. It was possible to better these figures slightly on material for shipment from the East. Barium salts were unchanged in price and were in only fair demand. *Barium chloride* was offered in small or moderate lots at $110 per ton. The *carbonate* was quiet and supplies were available at $90 per ton. *White arsenic* continued very scarce and high priced with only a few very small lots offered at 17c. per lb. The shortage of arsenic has had an adverse effect on the copper sulphate market and very little of the material is moving. Due to the strength of the metal, however, the price has been maintained at 6c. per lb. for less than carload lots. *Carbon tetrachloride* was firm and unchanged at 10½@11c. per lb. in large drums. *Carbon bisulphide* continued scarce and the spot price was well maintained. The best offer for delivery from stock was 7½c. per lb., but it was possible to do some better on material for shipment from the works. Moderate lots of *formaldehyde* moved to the consuming trade and the price was firm at 17c. per lb. in less than 5-bbl. lots. *Furfural* was available at 25c. per lb. in 1,000-lb. lots and should find a good market if formaldehyde continues to advance. *Glycerine* was quiet and supplies of the c.p material were available in drums at 18@18½c. per lb.

Phosphoric anhydride was in better demand, but the price was unchanged at 40c. per lb. for 1-lb. tins in case lots. *Cyanide of potash* was firm and unchanged at 55c. per lb. *Yellow prussiate of potash* was weaker on spot and supplies were available at 40c. per lb. The *red prussiate of potash* was also weaker and it was possible to do 92c. per lb. in single cask lots.

LINSEED OIL AND TURPENTINE

Buyers were not interested in linseed oil and only small quantities were moving. Boiled oil in single-drum lots was quoted at 96c. per gal. and the raw in similar lots at 94c.

Turpentine was too high priced to be of interest to most buyers and consequently very little moved. Today's price for single drums was $1.59 per gal.

Steel Market Continues Active

Prices Are Stiffening and Consumption Is at a Higher Rate

PITTSBURGH, Jan. 19, 1923.

The steel market continues at the active rate reached in December, there being very free placing of orders by all classes of buyers, though it is noticeable that the proportion of early delivery business is larger than what might be considered normal. Prices are stiffening, in general, and while it can hardly be said that the whole steel market is in the act of advancing, there is something occurring along that line.

The various steel consuming lines appear to be operating at somewhat better rates than in December.

PRODUCTION AND LABOR SUPPLY

The rate of steel production seems to depend chiefly upon labor supply. The actual physical capacity, between 50,000,000 and 55,000,000 tons of ingots a year, is far above the recent operating rate or any that is likely to be attained. While labor supply has improved somewhat since October, it has not improved as much as might have been predicted on the basis of the season of year, which curtails outdoor work and must release many men. As construction activity promises to be as heavy this spring as last autumn, if not heavier, the steel industry's prospect is that it will have a greater labor shortage next April than it had last October.

Steel ingot production was quite uniform during the last 3 months of the old year at a rate of about 40,000,000 tons a year, representing somewhat more than 75 per cent of capacity. By the end of this month the rate may be 5 per cent better and the high point may represent a gain of 10 per cent, the high point naturally falling in March, always a good month for operation. For later months, much depends on labor supply and something may depend on the pressure of buyers for deliveries, though in general it looks as though the steel industry could run fairly well on momentum to the middle of the year, even should the present buying movement taper off, of which there is no sign thus far.

In most finished steel products there is more or less of a rising tendency. With one exception, conspicuous in consequence, this tendency is seen only in what is frequently called "the independent market," which has sometimes, and particularly in 1920, been an entirely separate institution. The Steel Corporation's general policy, as exemplified by its action last November in continuing its old sheet and tin plate prices, has been to make no advances. Shapes and plates, however, it has advanced this week, from 2c. to 2.10c., while it leaves bars at the old price of 2c. The object seems to be to restore the old differential, which ruled pretty steadily before the war. Among the independents at least bars have really been stronger marketwise than plates or shapes for some time past.

The Cambria Steel Co. started the advancing movement in the heavy rolled steel products late last week, advancing its price on bars, shapes and plates from 2c. to 2.10c., and other independents have been following, practically all being now on a 2.10c. basis. This make the market 2@2.10c. on bars and 2.10c. on shapes and plates. A few independent mills are quoting above 2.10c. on the less desirable plate business.

RISING PRICE TENDENCY

An advance in the independent market in sheets is imminent, several mills having already withdrawn from the market at the old prices. The Steel Corporation could hardly take action in any event, as it is practically sold up on sheets until June. The regular market is 2.50c. on blue annealed, 3.35c. on blacks, 4.35c. on galvanized and 4.70@5c. on automobile sheets. A respectable tonnage of blue annealed, for early delivery, is now going at 2.60c. The prediction is that the independents will advance black and galvanized $3 a ton, to 3.50c. and 4.50c. respectively. They are all sold for a large part of the current quarter and an advance if made will doubtless carry with it an opening of order books for the second quarter.

Semi-finished steel, including billets, slabs and sheet bars, is strong at its recent advance of $1 a ton in the minimum, and offerings are scant, the market being quotable at $37.50@$38.50.

Pig iron is rather quiet in point of turnover, the quietness attracting some attention. Prices are steady or firm, but are not being very seriously tested, as the inquiry is almost entirely for small prompt lots. The market stands at $27.50 for bessemer, $25@$26 for basic and $27@$28 for foundry, f.o.b. valley furnaces.

Connellsville coke has softened a trifle in the week, but shows little sign of receding to its level of early in December, prompt furnace being now at $8@$8.25 and prompt foundry at $9@$9.25. There is no interest whatever exhibited in the matter of second quarter contracts. Connellsville steam coal is off somewhat, frequently going at as low as $2.75, byproduct holding firm at $3.75@$4.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0.39 - $0.41
Acetone, drums	lb.	.21 - .21½
Acid, acetic, 28%, bbl.	100 lb.	3.50 - 3.60
Acetic, 56%, bbl.	100 lb.	7.00 - 7.15
Glacial, 99½%, carboys	100 lb.	12.80 - 13.25
Boric, crystals, bbl.	lb.	.11½ - .11¾
Boric, powder, bbl.	lb.	.11 - .11½
Citric, kegs	lb.	.49 - .50
Formic, 85%	lb.	.18 - .19
Gallic, tech.	lb.	.45 - .50
Hydrochloric, 18° tanks	100 lb.	.80 - 1.00
Hydrofluoric, 52%, carboys	lb.	.12 - .12½
Lactic, 44%, tech., light, bbl.	lb.	.11 - .11½
22% tech., light, bbl.	lb.	.05 - .05½
Muriatic, 20°, tanks	100 lb.	1.00 - 1.10
Nitric, 36°, carboys	lb.	.04½ - .05
Nitric, 42°, carboys	lb.	.06 - .06½
Oleum, 20%, tanks	ton	17.00 - 18.00
Oxalic, crystals, bbl.	lb.	.13 - .13½
Phosphoric, 50% carboys	lb.	.08½ - .09
Pyrogallic, resublimed	lb.	1.50 - 1.60
Sulphuric, 60°, tanks	ton	9.00 - 10.00
Sulphuric, 60°, drums	ton	12.00 - 14.00
Sulphuric, 66°, tanks	ton	14.50 - 15.00
Sulphuric, 66° drums	ton	19.00 - 20.00
Tannic, U.S.P., bbl.	lb.	.65 - .70
Tannic, tech., bbl.	lb.	.40 - .45
Tartaric, imp. crys., bbl.	lb.	.30½ - .31
Tartaric, imp., powd., bbl.	lb.	.31 - .32
Tartaric, domestic, bbl.	lb.	.... - .32
Tungstic, per lb. of WO	lb.	1.00 - 1.20
Alcohol, butyl, drums	gal.	.18 - .23
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 - 4.95
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 188 proof No. 1	gal.	.39 - .41
Alum, ammonia, lump, bbl.	lb.	.03½ - .03¾
Potash, lump, bbl.	lb.	.03½ - .03¾
Chrome, lump, potash, bbl.	lb.	.05 - .05½
Aluminum sulphate, com., bags	100 lb.	1.50 - 1.65
Iron free bags	lb.	.02½ - .02¾
Aqua ammonia, 26°, drums	lb.	.06½ - .07½
Ammonia, anhydrous, cyl.	lb.	.30 - .30½
Ammonium carbonate, powd. casks	lb.	.09 - .09½
Ammonium nitrate, tech., casks	lb.	.10 - .11
Amyl acetate tech., drums	gal.	2.80 - 3.05
Arsenic, white, powd., bbl.	lb.	.15½ - .15¾
Arsenic, red, powd., kegs	lb.	.13 - .13½
Barium carbonate, bbl.	ton	75.00 - 77.00
Barium chloride, bbl.	ton	94.00 - 100.00
Barium dioxide, drums	lb.	.18 - .18½
Barium nitrate, casks	....	.08½ - .08¾
Barium sulphate, bbl.	lb.	.04 - .04½
Blanc fixe, dry, bbl.	lb.	.04 - .04½
Blanc fixe, pulp, bbl.	ton	45.00 - 55.00
Bleaching powder, f.o.b. wks., drums	100 lb.	2.00 - 2.50
Resale drums	100 lb.	2.25 - 2.50
Borax, bbl.	lb.	.05½ - .05¾
Bromine, cases	lb.	.27 - .28
Calcium acetate, bags	100 lb.	3.50 - 3.60
Calcium carbide, drums	lb.	.04½ - .04¾
Calcium chloride, fused, drums	ton	22.00 - 23.00
Gran. drums	lb.	.01½ - .01¾
Calcium phosphate, mono, bbl.	lb.	.06½ - .07
Camphor, cases	lb.	.93 - .95
Carbon bisulphide, drums	lb.	.07 - .07½
Carbon tetrachloride, drums	lb.	.10 - .10½
Chalk, precip.—domestic, light, bbl.	lb.	.04½ - .04¾
Domestic, heavy, bbl.	lb.	.03½ - .03¾
Imported, light, bbl.	lb.	.04½ - .05
Chlorine, liquid, cylinders	lb.	.06 - .06½
Chloroform, tech., drums	lb.	.35 - .38
Cobalt oxide, bbl.	lb.	2.10 - 2.25
Copperas, bulk, f.o.b. wks.	ton	20.00 - 22.00
Copper carbonate, bbl.	lb.	.20 - .20½
Copper cyanide, drums	lb.	.50 - .55
Coppersulphate, crys., bbl.	100 lb.	6.00 - 6.25
Cream of tartar, bbl.	lb.	.25 - .26
Dextrine, corn, bags	100 lb.	3.25 . 3.50
Epsom salt, dom., tech., bbl.	100 lb.	2.10 - 2.25
Epsom salt, imp., tech., bags	100 lb.	1.10 - 1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.50 - 2.75
Ether, U.S.P., drums	lb.	.13 - .15
Ethyl acetate, com., 85%, drums	gal.	.80 - .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 - 1.00
Formaldehyde, 40%, bbl.	lb.	.16 - .16½
Fullers earth, f.o.b. mines	net ton	$16.00 - $17.00
Fullers earth—imp., powd.	net ton	30.00 - 32.00
Fusel oil, ref., drums	gal.	3.55 - 4.05
Fusel oil, crude, drums	gal.	2.30 - 2.40
Glaubers salt, wks., bags	100 lb.	1.20 - 1.40
Glaubers salt, imp., bags	100 lb.	1.00 - 1.25
Glycerine, c.p., drums extra	lb.	.18½ - .19
Glycerine, dynamite, drums	lb.	.17 - .17¼
Iodine, resublimed	lb.	4.50 - 4.60
Iron oxide, red, casks	lb.	.12 - .18
Lead:		
White, basic cabonate, dry, casks	lb.	.08 - .08¾
White, in oil, kegs	lb.	.10½ - .12
Red, dry, casks	lb.	.10½ - .10¾
Red, in oil, kegs	lb.	.12 - .14
Lead acetate, white crys., bbl.	lb.	.13 - .13½
Lead arsenate, powd., bbl.	lb.	.21 - .22
Lime-Hydrated, bbl.	per ton	16.88 - 17.00
Lime, Lump, bbl.	280 lb.	3.63 - 3.65
Litharge, comm., casks	lb.	.09½ - .10
Lithophone, bbl.	lb.	.06½ - .07
Magnesium carb., tech., bags	lb.	.07 - .07½
Methanol, 95%, bbl.	gal.	1.23 - 1.25
Methanol, 97%, bbl.	gal.	1.25 - 1.27
Nickel salt, double, bbl.	lb.	.10 - .10½
Nickel salts, single, bbl.	lb.	.11 - .11½
Phosgene	....	.60 - .75
Phosphorus, red, cases	lb.	.35 - .40
Phosphorus, yellow, cases	lb.	.30 - .35
Potassium bichromate, casks	lb.	.10 - .10½
Potassium bromide, gran., bbl.	lb.	.18 - .25
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½ - .06
Potassium chlorate, powd.	lb.	.07½ - .08
Potassium cyanide, drums	lb.	.47 - .80
Potassium hydroxide (caustic potash) drums	100 lb.	7.00 - 7.25
Potassium iodide, cases	lb.	3.55 - 3.65
Potassium nitrate, bbl.	lb.	.06½ - .07
Potassium permanganate, drums	lb.	.16 - .16½
Potassium prussiate, red, casks	lb.	.85 - .90
Potassium prussiate, yellow, casks	lb.	.38 - .39
Salammoniac, white, gran., casks	lb.	.06½ - .06¾
Gray, gran., casks	lb.	.08 - .08½
Salsoda, bbl.	100 lb.	1.20 - 1.40
Salt cake (bulk)	ton	25.00 - 27.00
Soda ash, light, 58% flat, bags, contract	100 lb.	1.60 - 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks.	100 lb.	1.20 - 1.30
Soda ash, light, 58%, flat, bags, resale	100 lb.	1.75 - 1.80
Soda ash, dense, bags, contract, basis 48%	100 lb.	1.17½ - 1.20
Soda ash, dense, in bags, resale	100 lb.	1.85 - 1.90
Soda, caustic, 76%, solid, drums, f.a.s.	100 lb.	3.45 - 3.70
Soda, caustic, 76%, solid, drums, contract	100 lb.	3.35 3.40
Soda, caustic, basis 60%, wks., contract	100 lb.	2.50 - 2.60
Soda, caustic, ground and flake, contracts	100 lb.	3.80 - 3.90
Soda, caustic, ground and flake, resale	100 lb.	4.00 - 4.15
Sodium acetate, works, bags	lb.	.06½ - .07
Sodium bicarbonate, bbl.	100 lb.	1.75 - 1.85
Sodium bichromate, casks	lb.	.07¾ - .08
Sodium bisulphate (niter cake)	ton	6.00 - 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ - .04¾
Sodium chlorate, kegs	lb.	.06½ - .07
Sodium chloride	long ton	12.00 - 13.00
Sodium cyanide, cases	lb.	.19 - .23
Sodium fluoride, bbl.	lb.	.09 - .10
Sodium hyposulphite, bbl.	lb.	.03 - .03¼
Sodium nitrite, casks	lb.	.08½ - .09
Sodium peroxide, powd., cases	lb.	.28 - .30
Sodium phosphate, dibasic, bbl.	lb.	.03½ - .04
Sodium prussiate, yel. drums	lb.	.18½ - .20
Sodium silicate (40°, drums)	100 lb.	.80 - 1.15
Sodium silicate (60°, drums)	100 lb.	2.25 - 2.40
Sodium sulphide, fused, 60-62% drums	lb.	.04½ - .04¾
Sodium sulphite, crys., bbl.	lb.	.03½ - .03¾
Strontium nitrate, powd., bbl.	lb.	.09½ - .10½
Sulphur chloride, yel drums	lb.	.04½ - .05
Sulphur, crude	ton	18.00 - 20.00½
Sulphur dioxide, liquid, cyl.	lb.	.08 - .08
Sulphur, flour, bbl.	100 lb.	2.50 - 3.15
Sulphur, roll, bbl.	100 lb.	2.15 - 2.20
Talc—imported, bags	ton	$30.00 - $40.00
Talc—domestic powd., bags	ton	18.00 - 25.00
Tin bichloride, bbl.	lb.	.11 - .11½
Tin oxide, bbl.	lb.	.45 - .47
Zinc carbonate, bags	lb.	.14 - .14½
Zinc chloride, gran, bbl.	lb.	.07 - .07½
Zinc cyanide, drums	lb.	.42 - .44
Zinc oxide, XX, bbl.	lb.	.07½ - .08
Zinc sulphate, bbl.	100 lb.	2.75 - 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$ .95 - $1.00
Alpha-naphthol, ref., bbl.	lb.	1.05 - 1.10
Alpha-naphthylamine, bbl.	lb.	.28 - .30
Aniline oil, drums	lb.	.16½ - .17
Aniline salts, bbl.	lb.	.24 - .25
Anthracene, 80%, drums	lb.	.75 - 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 - .70
Anthraquinone, 25%, paste, drums	lb.	.70 - .75
Benzaldehyde U.S.P., carboys	lb.	1.35 - 1.40
Benzene, pure, water-white, tanks and drums	gal.	.35 - .40
Benzene, 90%, drums	gal.	.26 - .32
Benzene, 90%, drums, resale	gal.	.34 - .35
Benzidine base, bbl.	lb.	.85 - .90
Benzidine sulphate, bbl.	lb.	.75 - .80
Benzoic acid, U.S.P., kegs	lb.	.72 - .75
Benzoate of soda, U.S.P., bbl.	lb.	.57 - .65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 - .27
Benzyl chloride, tech., drums	lb.	.20 - .23
Beta-naphthol, subl., bbl.	lb.	.55 - .60
Beta-naphthol, tech., bbl.	lb.	.25 - .26
Beta-naphthylamine, tech.	lb.	1.00 - 1.25
Carbazol, bbl.	lb.	.75 - .90
Cresol, U.S.P., drums	lb.	.14 - .20
Ortho-cresol, drums	lb.	.18 - .22
Cresylic acid, 97%, resale, drums	gal.	1.25 - 1.30
95-97%, drums, resale	gal.	.95 - 1.00
Dichlorbenzene, drums	lb.	.07 - .09
Diethylaniline, drums	lb.	.50 - .60
Dimethylaniline, drums	lb.	.39 - .41
Dinitrobenzene, bbl.	lb.	.20 - .22
Dinitroclorbenzene, bbl.	lb.	.22 - .23
Dinitronaphthalene, bbl.	lb.	.30 - .32
Dinitrophenol, bbl.	lb.	.35 - .40
Dinitrotoluene, bbl.	lb.	.22 - .24
Dip oil, 25%, drums	gal.	.25 - .30
Diphenylamine, bbl.	lb.	.54 - .56
H-acid, bbl.	lb.	.75 - .80
Meta-phenylenediamine, bbl.	lb.	.95 - 1.00
Michlers ketone, bbl.	lb.	3.50 - 3.75
Monochlorbenzene, drums	lb.	.08 - .10
Monoethylaniline, drums	lb.	.95 - 1.10
Naphthalene, crushed, bbl.	lb.	.05½ - .06
Naphthalene, flake, bbl.	lb.	.06 - .06½
Naphthalene, balls, bbl.	lb.	.07 - .07½
Naphthionate of soda, bbl.	lb.	.58 - .65
Naphthionic acid, crude, bbl.	lb.	.60 - .65
Nitrobenzene, drums	lb.	.10 - .12
Nitro-naphthalene, bbl.	lb.	.30 - .35
Nitro-toluene, drums	lb.	.15 - .17
N-W acid, bbl.	lb.	1.20 - 1.30
Ortho-amidophenol, kegs	lb.	2.30 - 2.35
Ortho-dichlorbenzene, drums	lb.	.17 - .20
Ortho-nitrophenol, bbl.	lb.	.90 - .92
Ortho-nitrotoluene, drums	lb.	.12½ - .14
Ortho-toluidine, bbl.	lb.	.14 - .16
Para-amidophenol, base, kegs	lb.	1.25 - 1.30
Para-amidophenol, HCl, kegs	lb.	1.30 - 1.35
Para-dichlorbenzene, bbl.	lb.	.17 - .20
Paranitraniline, bbl.	lb.	.75 - .80
Para-nitrotoluene, bbl.	lb.	.55 - .65
Para-phenylenediamine, bbl.	lb.	1.50 - 1.55
Para-toluidine, bbl.	lb.	.85 - .90
Phthalic anhydride, bbl.	lb.	.35 - .38
Phenol, U.S.P., drums	lb.	.35 - .37
Picric acid, bbl.	lb.	.20 - .22
Pyridine, dom., drums	gal.	nominal
Pyridine, imp., drums	gal.	2.80 - 3.00
Resorcinol, tech., kegs	lb.	1.50 - 1.55
Resorcinol, pure, kegs	lb.	2.00 - 2.10
R-salt, bbl.	lb.	.55 - .60
Salicylic acid, tech., bbl.	lb.	.40 - .42
Salicylic acid, U.S.P., bbl.	lb.	.45 - .47
Solvent naphtha, water-white, drums	gal.	.37 - .40
Crude, drums	gal.	.22 - .24
Sulphanilic acid, crude, bbl.	lb.	.20 - .22
Thiocarbanilide, kegs	lb.	.35 - .38
Toluidine, kegs	lb.	1.20 - 1.30
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars	gal.	.35 - .37
Toluene, drums	gal.	.40 - .43
Xylidines, drums	lb.	.40 - .45
Xylene, pure, drums	gal.	.45 - .50
Xylene, com., drums	gal.	.40 - .42
Xylene, com., tanks	gal.	.30 - ....

Naval Stores

Rosin B-D, bbl	280 lb.	$6.15 – ....
Rosin E-I, bbl	280 lb.	6.30 – ....
Rosin K-N, bbl	280 lb.	6.50 – $6.75
Rosin W.G.-W.W., bbl	280 lb.	7.75 – 8.25
Wood rosin, bbl	280 lb.	6.25 – ....
Turpentine, spirits of, bbl	gal.	1.53 – 1.54
Wood, steam dist., bbl	gal.	1.35 – ....
Wood, dest. dist., bbl	gal.	1.25 – ....
Pine tar pitch, bbl	200 lb.	.... – 6.00
Tar, kiln burned, bbl	500 lb.	.... – 12.50
Retort tar, bbl	500 lb.	.... – 11.00
Rosin oil, first run, bbl	gal.	.43 – ....
Rosin oil, second run, bbl	gal.	.47 – ....
Rosin oil, third run, bbl	gal.	.53 – ....
Pine oil, steam dist.	gal.	.... – .90
Pine oil, pure, dest. dist.	gal.	.... – .85
Pine tar oil, ref.	gal.	.... – .46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.... – .35
Pine tar oil, double ref., bbl.	gal.	.... – .75
Pine tar, ref., thin, bbl	gal.	.... – .25
Pinewood creosote, ref., bbl.	gal.	.... – .52

Vegetable Oils

Castor oil, No. 3, bbl	lb.	$.11½ – $.12½
Castor oil, AA, bbl	lb.	.12½ – .12¾
Chinawood oil, bbl	lb.	.16 – .16½
Coconut oil, Ceylon, bbl	lb.	.09½ – .10
Coconut oil, Cochin, bbl	lb.	.10 – .10½
Corn oil, crude, bbl	lb.	.11 – .11½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½ – ....
Summer yellow, bbl	lb.	.11½ – .11¾
Winter yellow, bbl	lb.	.11¾ – .12
Linseed oil, raw, car lots, bbl	gal.	.90 – .91
Raw, tank cars (dom.)	gal.	.89 – .90
Boiled, 5-bbl. lots (dom.)	gal.	.95 – .96
Olive oil, denatured, bbl	gal.	1.10 – 1.15
Palm, Lagos, casks	lb.	.08 – .08½
Palm kernel, bbl	lb.	.08½ – .09
Peanut oil, crude, tanks (mill)	lb.	.12½ – .13
Peanut oil, refined, bbl	lb.	.15½ – .16
Rapeseed oil, refined, bbl	gal.	.83 – .84
Rapeseed oil, blown, bbl	gal.	.87 – .88
Soya bean (Manchurian), bbl.	lb.	.11½ – ....
Tank, f.o.b. Pacific coast	lb.	.09½ – .09¾

Fish Oils

Menhaden, light pressed, bbl.	gal.	$0.60 – ....
White bleached, bbl	gal.	.64 – .65
Blown, bbl	gal.	.68 – .69
Whale No. 1 crude, tanks, coast	lb.	.06 – .06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38.00 – $39.00
Fustic, sticks	ton	30.00 – 35.00
Fustic, chips, bags	lb.	.04 – .05
Logwood, sticks	ton	28.00 – 30.00
Logwood, chips, bags	lb.	.02½ – .03½
Sumac, leaves, Sicily, bags	ton	65.00 – ....
Sumac, ground, bags	ton	55.00 – 60.00
Sumac, domestic, bags	ton	35.00 – ....
Tapioca flour, bags	lb.	.03½ – .05

EXTRACTS

Archil, conc., bbl	lb.	$0.18 – $0.20
Chestnut, 25% tannin, tanks	lb.	.02 – .03
Divi-divi, 25% tannin, bbl	lb.	.04 – .05
Fustic, crystals, bbl	lb.	.20 – .22
Fustic, liquid, 42°, bbl	lb.	.08 – .09
Gambier, liq., 25% tannin, bbl.	lb.	.08 – .09
Hematine crys., bbl	lb.	.14 – .18
Hemlock, 25% tannin, bbl	lb.	.04 – .05
Hypernic, solid, drums	lb.	.24 – .26
Hypernic, liquid, 51°, bbl	lb.	.14 – .17
Logwood, crys., bbl	lb.	.19 – .20
Logwood, liq., 51°, bbl	lb.	.09 – .10
Quebracho, solid, 65% tannin, bbl	lb.	.04½ – .05
Sumac, dom., 51°, bbl	lb.	.06½ – .07

Waxes

Bayberry, bbl	lb.	$0.30 – $0.31
Beeswax, refined, dark, bags	lb.	.30 – .32
Beeswax, refined, light, bags	lb.	.34 – .35
Beeswax, pure white, cases	lb.	.40 – .41
Candelilla, bags	lb.	.34 – .35
Carnauba, No. 1, bags	lb.	.38 – .40
No. 2, North Country, bags	lb.	.23 – .24
No. 3, North Country, bags	lb.	.17 – .17½
Japan, cases	lb.	.15 – .15½
Montan, crude, bags	lb.	.03½ – .04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 – .04½
Crude, scale 124-126 m.p., bags	lb.	.02½ – .02¾
Ref., 118-120 m.p., bags	lb.	.03¼ – .03½
Ref., 125 m.p., bags	lb.	.03½ – .03¾
Ref., 128-130 m.p., bags	lb.	.04 – .04¼
Ref., 133-135 m.p., bags	lb.	.04½ – .04¾
Ref., 135-137 m.p., bags	lb.	.05 – .05½
Stearic acid, single pressed, bags	lb.	.10 – .10½
Double pressed, bags	lb.	.10½ – .10¾
Triple pressed, bags	lb.	.11 – .11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 – $3.25
F.a.s. double bags	100 lb.	3.60 – 3.75
Blood, dried, bulk	unit	4.60 – ....
Bone, raw, 3 and 50, ground	ton	30.00 – 35.00
Fish scrap, dom., dried, wks.	unit	5.00 – 5.10
Nitrate of soda, bags	100 lb.	2.60 – 2.65
Tankage, high grade, f.o.b. Chicago	unit	4.60 – 4.65

Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 – $4.00
Tennessee, 78-80%	ton	7.00 – 8.00
Potassium muriate, 80%, bags	ton	35.55 – 38.25
Potassium sulphate, bags	unit	1.00 – ....

Crude Rubber

Para—Upriver fine	lb.	$0.29 – $0.29½
Upriver coarse	lb.	.24 – .24½
Upriver caucho ball	lb.	.26 – .26½
Plantation—First latex crepe	lb.	.34 – .34½
Ribbed smoked sheets	lb.	.34 – .34½
Brown crepe, thin, clean	lb.	.27 – .28
Amber crepe No. 1	lb.	.27 – .28

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 – $550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60.00 – 80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 – 17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 – 20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 – 21.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	24.00 – 28.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00 – 9.00
Casein, bbl., tech.	lb.	.12 – .14
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 – 9.00
Washed, f.o.b. Ga.	net ton	8.00 – 9.00
Powd., f.o.b. Ga.	net ton	14.00 – 20.00
Crude f.o.b. Va.	net ton	8.00 – 12.00
Ground, f.o.b. Va.	net ton	13.00 – 20.00
Imp., lump, bulk	net ton	14.00 – 20.00
Imp., powd.	net ton	40.00 – 45.00
Feldspar, No. 1 pottery	long ton	6.00 – 7.00
No. 2 pottery	long ton	5.00 – 5.50
No. 1 soap	long ton	7.00 – 7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 – 21.00
Graphite, Ceylon, lump, first quality, bbl	lb.	.05 – .05½
Ceylon, chip, bbl.	lb.	.04 – .04½
High grade amorphous crude	ton	35.00 – 50.00
Gum arabic, amber, sorts, bags	lb.	.15 – .16
Gum tragacanth, sorts, bags	lb.	.50 – .60
No. 1, bags	lb.	1.75 – 1.80
Kieselguhr, f.o.b. Cal	ton	40.00 – 42.00
F.o.b. N. Y.	ton	50.00 – 55.00
Magnesite, crude, f.o.b. Cal	ton	14.00 – 15.00
Pumice stone, imp., casks	lb.	.03 – .05½
Dom., lump, bbl	lb.	.05 – .05½
Dom., ground, bbl	lb.	.06 – .07
Shellac, orange fine, bags	lb.	.83 – .84
Orange superfine, bags	lb.	.85 – .86
A. C. garnet, bags	lb.	.80 – .81
T. N., bags	lb.	.81 – .82
Silica, glass sand, f.o.b. Ind.	ton	2.00 – 2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50 5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 – 17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 – 2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 – 8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 – 9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 – 9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 – 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N. Y.	ton	$200.00 – $225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11 – .11½
4-6% C	lb.	.11½ – .12
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	102.50 – 107.50
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 – 37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 – 2.15
Ferrosilicon, 10-15%	gr. ton	38.00 – 40.00
50%	gr. ton	80.00 – 85.00
75%	gr. ton	150.00 – 160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 – $0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 – ....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 – 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.00 – $9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 – 23.00
C.i.f. Atlantic seaboard	ton	18.50 – 19.00
Coke, fdry., f.o.b. ovens	ton	9.00 – 9.25
Coke, furnace, f.o.b. ovens	ton	8.00 – 8.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17.50 – ....
Fluorspar, No. 2 Lump—Ky. & Ill. mines	ton	25.00 – ....
Ilmenite, 52% TiO_2	lb.	.01½ – .01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.30 – ....
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.70 – .75
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 – .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	Nominal
Rutile, 95% TiO_2	lb.	.12 – ....
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 – 8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 – 8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 – 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25 – 2.50
Vanadium pentoxide, 99%	lb.	12.00 – 14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 – ....
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½ – .13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14.625
Aluminum, 98 to 99%	22.00–23.00
Antimony, wholesale, Chinese and Japanese	6.62–7.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	38.625
Lead, New York, spot	7.60
Lead, E. St. Louis, spot	7.55
Zinc, spot, New York	7.05–7.10
Zinc, spot, E. St. Louis	6.70–6.75

OTHER METALS

Silver (commercial)	oz.	$0.65½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.50
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz.	110.00
Iridium	oz.	250.00@275.00
Palladium	oz.	65.00@70.00
Mercury	75 lb.	72.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11.25@11.50
Copper, light and bottoms	9.25@9.50
Lead, heavy	5.75@6.00
Lead, tea	3.50@3.75
Brass, heavy	6.25@6.40
Brass, light	5.35@5.75
No. 1 yellow brass turnings	6.30@6.50
Zinc	3.50@4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.14	$3.14
Soft steel bars	3.04	3.04
Soft steel bar shapes	3.04	3.04
Soft steel bands	3.84	3.84
Plates, ¼ to 1 in. thick	3.14	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

RIVER FALLS—The Andalusia Brick Co. has plans under way for extensions and improvements in its plant, including the installation of considerable additional equipment. O. L. Benson, Andalusia; and Harold Stanley, River Falls, head the company.

Arkansas

LITTLE ROCK—The Arkansas Brick & Tile Co. has inquiries out for power equipment and other operating machinery for installation at its plant.

California

TOBY (Kern County)—The Fremont Salt Co., is planning for extensions and improvements in its plant at Toby, near Mojave, estimated to cost about $50,000, including equipment. J. C. Martin is general manager.

SAN DIEGO—The Savage Tire Co., manufacturer of automobile tires, will install additional equipment at its plant for considerable increase in production.

LOS ANGELES—The Soda & Potash Corp., recently organized with a capital of 350,000 shares of stock, no par value, is perfecting plans for the construction of a new plant on local site secured some time ago. The works will include an experimental laboratory for developing new processes of manufacture, and are estimated to cost in excess of $1,500,000, including machinery. The company is also arranging for the operation of raw material lands in Nevada, where extensive deposits of sodium sulphate, carbonate and bicarbonate are available. C. W. Culpepper is president; Edward P. Shaw, treasurer; and F. J. McGuire, secretary.

SANTA BARBARA—The Shell Co. of California, San Francisco, has acquired property at Salsipuedes Ave., near Milpas St., as a site for the construction of a new storage and distributing plant, estimated to cost in excess of $500,000, with equipment. Work will be placed under way at an early date. Headquarters are at 343 Sansome St., San Francisco.

SAN FRANCISCO—The Western Sugar Refinery, 2 Pine St., will commence the immediate erection of a new 1-story building at its plant, covering two city blocks on 23d and Delaware Sts., estimated to cost about $245,000. The company is a subsidiary of the Spreckels Sugar Co., same address.

OAKLAND—The Richmond Sanitary Mfg. Co., manufacturer of sanitary ware, has awarded a contract to Sommerstrom Brothers, 306 14th St., Oakland, for the erection of a new 2-story building at 9th and Alice Sts., estimated to cost about $25,000. L. L. Ford, 306 14th St., is architect.

TEHACHAPI—The Henry Cowell Lime & Cement Co., 2 Market St., San Francisco, is said to be perfecting plans for the early erection of its proposed new cement-manufacturing plant on property recently acquired at Tehachapi, near Bakersfield, estimated to cost more than $1,000,000, with machinery.

RICHMOND—The Synthetic Iron Coloring Products Co., 17th and Chanslor Sts., is planning for the rebuilding of the portion of its drying department recently destroyed by fire.

PITTSBURG—The Columbia Steel Corp., recently organized with a capital of $20,000,000, to take over and merge the Columbia Steel So., with local mills, and the Utah Coal & Coke Co., Salt Lake City, has plans under way for extensions and improvements in the Pittsburg works, to include the erection of a number of new mills and open-hearth furnaces. The work will cost in excess of $500,000. Wigginton E. Creed, head of the Pacific Gas & Electric Corp., 445 Sutter St., San Francisco, is president of the new corporation.

Florida

TAMPA—The Citrus Growers' Supply Co., recently formed with a capital of $25,000, has plans under consideration for the establishment of a new plant for the manufacture of insecticides for use on citrus trees. B. M. Starnes is president, and R. B. Campbell, vice-president.

Georgia

AUGUSTA—Merry Brothers, operating a local brick-manufacturing plant at the foot of Gwinnett St., will install additional equipment for the manufacture of hollow tile. A new kiln, about 800 ft. long, is being constructed. The company is headed by A. H. and E. B. Merry.

Illinois

CHICAGO—G. K. Nikolas & Co., 1227 West Van Buren St., mannufacturers of lacquers and kindred products, will soon award a general contract for the erection of their proposed new 3-story plant, 50x70 ft., adjoining the present works, to cost approximately $50,000. Meyer & Cook, 30 North Dearborn St., Chicago, are architects.

TAYLORVILLE—The Hopper Paper Co. has acquired the local plant of the E-Z Opener Bag Co., and will use the structure in connection with its proposed new paper mill, for which plans are being completed. The new mill to be constructed will be located on an adjoining site and is estimated to cost $75,000; with the present building, it will provide for an initial capacity of about 20 tons per day. B. Hopper is president, and K. R. Cobine, secretary, treasurer and general manager; Walter H. Provine, Taylorville, is vice-president in charge.

Indiana

EAST CHICAGO—The Pressed Steel Mfg. Co., of East Chicago, Ind., announces that it will begin construction on its 2-story factory and office structure this year; the building to be used for the production of the Murphy steel car ends. According to plans the company proposes to build a brick, steel and concrete structure to cost $700,000.

INDIANAPOLIS—The Marion Paint Co., 358 South Meridian St., has leased a building at 366 Meridian St., for extensions in its plant. Additional equipment will be installed for considerable increased production.

NEW ALBANY—The Gohmann Brothers & Taylor Co., Silver St., is planning for the erection of a 2-story and basement foundry, 30x220 ft., at its stove and range works, estimated to cost approximately $35,000. Bids will be asked at an early date. Arthur R. Smith, Norton Bldg., Louisville, Ky., is architect in charge.

PENDLETON — The Reformatory Board, Indianapolis, has tentative plans under consideration for the construction of a foundry at the new Indiana Reformatory, Pendleton. J. W. Nash, Indianapolis; John O'Neil and Joseph E. Henning comprise the committee in charge of purchases. G. A. H. Shideler is superintendent at the institution.

INDIANAPOLIS—The Radio Chemical Co., recently organized, has arranged for the establishment of a new plant at 315 North Delaware St.

Louisiana

FOWLER—The Southern Carbon Co., Monroe, La., has plans under way for the construction of a new plant at Fowler, comprising 8 operating units for the production of carbon black and kindred specialties, estimated to cost approximately $800,000, with machinery. The company is also arranging for the erection of a new 2-unit plant at Spyker, and has commenced work on a 6-unit factory at Swartz. The entire project is expected to cost close to $1,500,000, including machinery.

Maryland

BALTIMORE—The Tin Decorating Co., Boston and Linwood Aves., has awarded a contract to the West Construction Co., American Bldg., for the erection of a new 1-story plant, 106x168 ft., estimated to cost about $45,000. Work will be placed under way at once.

Massachusetts

INDIAN ORCHARD—The Fiberloid Corp., manufacturer of celluloid composition products, has tentative plans under consideration for the rebuilding of the portion of its plant destroyed by fire, Jan. 8, with loss estimated at close to $50,000, including equipment.

MANISTEE—The Filer Fibre Co., Filer City, is pushing construction on its new local plant and plans to have the structure ready for the machinery installation at an early date. The innitial works will give employment to about 100 men. M. Oberdorfer is vice-president.

LUDDINGTON — The Stearns & Culver Salt Co. has work under way on enlargements and improvements in its plant to develop a capacity of about 600,000 bbl. of salt per year.

Nebraska

OMAHA—The Board of Trustees, Creighton University, has tentative plans in progress for the erection of a 4-story and basement chemistry building at the institution, estimated to cost approximately $300,000. John Latenser & Sons, 732 Peters Trust Bldg., are architects. John F. McCormick is president of the institution.

OMAHA—The Metropolitan Utilities District will build by day labor a new 2-story and basement filtration plant at 28th and Fillmore Sts., 130x240 ft., estimated to cost about $600,000, with equipment. F. D. Wead is chairman of the board.

New Jersey

NEWARK—The Utility Color & Chemical Co., 379-95 Frelinghuysen Ave., manufacturer of varnishes, colors, etc., is planning for the immediate rebuilding of the portion of its plant destroyed by fire, Jan. 9, with loss estimated at $35,000, including machinery and stock. Mortimer Davis is president.

NEWARK—The Eberhard Faber Rubber Co., New St., will commence the immediate erection of an addition to its plant at 60 Hoyt St., to cost about $25,000.

LAMBERTVILLE—The Perseverance Paper Mills, Inc., is perfecting arrangements for the rebuilding of the portion of its plant recently destroyed by fire. The company specializes in the production of newsprint under a new process. Henry Weeks is general manager.

ELIZABETH—The Durant Motor Co., Newark Ave., has commenced the installation of oven and other equipment, electrically operated, for drying and baking paints and enamels.

PLAUTERVILLE—Plans are being perfected by stockholders of the Smith Rubber & Tire Co., now in charge of William L. Brunyate, 304 Essex Bldg., Newark, trustee in bankruptcy, for a reorganization of the company and settlement of the receivership. Improvements and repairs will be made at the plant, closely following, and operations resumed.

New York

NEW YORK—The Vacuum Oil Co., 61 Broadway, manufacturer of lubricating oils, etc., has purchased property on the East River water front, from 10th to 11th St., for a consideration said to be $200,000, to be used as a site for a new storage and distributing plant for domestic and export purposes. The property was formerly a part of the plant of the Quintard Iron Works.

North Carolina

GREENSBORO—The Andrews Container Co., organized with a capital of $150,000, has acquired a local building to be equipped as a plant for the manufacture of solid fiber and corrugated products. O. B. Andrews is president.

Ohio

AKRON—The Benzol Motor Fuel Co. has construction under way on a new plant on East Tallmadge Ave., North Akron, for the manufacture of a new fuel for automobile service, composed of motor benzol and gasoline. The works are estimated to cost about $55,000, and will include storage tankage with capacity of approximately 20,000 gal. G. M. Tucker and C. C. Dilley will be in charge.

CINCINNATI—The Cincinnati Galvanizing Co., McMicken and Tafel Sts., will call for bids early in February for the construction of a new 2-story plant at Chickering St. and Spring Grove Ave., totaling about 15,000 sq.ft., estimated to cost approximately $150,000, including equipment. Carl

J. Kiefer, Room 810, Fourth National Bank, is architect and engineer. Christian Schott is president.

NILES—The Mahoning Valley Steel Co. is planning for immediate extensions and improvements in its plant, to include the remodeling of furnaces, installation of bar-shearing and other apparatus. The capacity will be considerably increased.

AKRON—The Goodyear Tire & Rubber Co. is planning for the immediate rebuilding of the portion of its chemical works, destroyed by fire, Jan. 3, with loss reported at $12,000.

Oklahoma

HENRYETTA—The Henryetta Glass Co., recently acquired by new interests, has plans under way for extensions and improvements, including the installation of additional equipment for increased production. F. A. Patterson heads the new organization.

ARDMORE—The Chickasaw Refining Corp., recently organized with a capital of $2,500,000, is perfecting plans for the operation of the local Chickasaw refinery. Extensions and improvements will be made in the plant. J. A. Cotner heads the company.

TULSA—The Sinclair Crude Producing Co., an interest of the Sinclair Consolidated Oil Corp., 45 Nassau St., New York, has plans nearing completion for extensions and improvements in its plant and system in the Salt Creek fields. The work will include a new pipe line, over 700 miles long, with pumping plants and auxiliary equipment. The expansion will cost approximately $500,000.

PAULS VALLEY—A bond issue of $188,000 has been approved for a waterworks system, to include a complete purification plant. V. V. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Pennsylvania

PHILADELPHIA—The American Bag & Paper Co., 2nd and Vine Sts., has taken bids on a general contract and will soon commence the erection of a new 7-story paper mill, 95x275 ft., at South Bainbridge, Water and Swanson Sts. Clarence E. Wunder, 1415 Locust St., is architect.

PHILADELPHIA—The Pennsylvania Brick & Tile Co. has filed plans for the erection of a new building at its proposed plant at Wensley St. and the Delaware River, for the manufacture of cement brick and kindred products. The ultimate plant is being designed for an output of 150,000 bricks per day. The company has recently been organized under state laws, with H. P. Marr, Kennett Sq., Pa., as treasurer.

CONSHOHOCKEN—The Ruth Glass Co. is arranging for the early installation of additional machinery for increased production. A day and night working schedule will soon be adopted. The company specializes in the manufacture of hollowware.

South Carolina

COLUMBIA—The Columbia Electro Plating Works, Inc., is planning for the rebuilding of the portion of its plant recently destroyed by fire. The estimated loss has not been announced.

Tennessee

UNION CITY — T. C. Fennell and R. E. Wilkins, both of Humboldt, Tenn., are planning for the organization of a company to establish and operate a tanning plant on property acquired at Union City.

Texas

DALLAS—The Oak Cliff Paper Mills, Inc., Oak Cliff, near Dallas, has plans nearing completion for additions and improvements in its plant for considerable increase in capacity. A new structure to be erected will be used primarily for the manufacture of fiber board, corrugated board and kindred products. The expansion is estimated to cost $150,000. E. T. Fleming is president.

CISCO—The Eastland-Pioneer Oil Refining Co., recently organized, has taken over the former local refining plant of the Liberty Refining Co., idle for some time past, and will make extensions and improvements to increase the capacity to about 6,000 bbl. per day. The present refinery will be thoroughly modernized. It is purposed to rush the work and have the plant ready for operation at an early date. R. E. Whitlock is general manager.

Virginia

HOPEWELL—In connection with extensions in its local pulp mill, the Stamscott Co., Inc., will make enlargements in its chemical department, devoted to the manufacture of specialties for the production of celluloid, lacquers and other products.

NEWPORT NEWS—Gateways, Inc., 128 24th St., recently organized, has acquired the local plant of the Duristo Paint Co., and will operate the property in the future. Extensions and improvements are planned. M. K. Armstrong is president of the new company, and E. D. Pettengill, treasurer.

Washington

PROSSER—The Prosser Evaporating Co. is considering plans for the rebuilding of the portion of its plant, destroyed by fire, Jan. 2, with loss estimated at about $15,000.

West Virginia

PARKERSBURG—The Blackwood Electric Steel Corp. has broken ground for the construction of the initial units of its new local plant, consisting of a number of 1-story buildings, with main structure, 140x230 ft. The plant will be equipped for the manufacture of electric steel castings. Mills, Rhines, Bellman & Nordoff, Ohio Bldg., Toledo, O., are architects and engineers. F. S. Blackwood heads the company.

Industrial Developments

GLASS—The American Window Glass Co. has resumed operations at its plant at Hartford City, Ind., following a curtailment for a number of days due to equipment breakage.

Hand-blowing glass plants in the vicinity of Clayton, N. J., are running at full capacity, giving employment to the largest number of workers in about 10 years past.

Window glass plants in Western Pennsylvania are operating at maximum output, with shipments of material during the past few weeks breaking all previous records. Working forces at a number of the factories are being increased.

CEMENT—The Coplay Portland Cement Co., Coplay, Pa., has resumed production at its local mill, following a shut down during the holidays for repair work.

The Phoenix Portland Cement Co., North Birmingham, Ala., is perfecting plans for the early completion of its new local mill which has been in course of construction for a number of months past. It is purposed to have the first units in full production early in May. The mill will have a rated ouput of 1,500,000 bbl. per year.

The Lehigh Portland Cement Co. has closed its Mill F at Coplay, Pa., for necessary repairs to equipment, and plans to resume as soon as the work has been completed, with production on a full capacity basis. At a later date, Mill D will be closed for a similar purpose.

The Alpha Portland Cement Co. is maintaining production at a normal basis at its mill at Alpha, N. J. The Edison Portland Cement Co. is also running full at its plant at New Village, N. J.

LEATHER—Tolman, Dow & Co., Inc., operating a tannery at Woburn, Mass., is running at close to normal, producing about 1,200 sides of buck and patent leather per day.

England, Walton & Co., Philadelphia, Pa., said to be the largest tanners in the world of oak belting butts, have advanced production about 30 per cent during the past 5 to 6 weeks. Increased working forces are being employed at the different tanneries.

The Murray Leather Co., Woburn, Mass., is operating a regular capacity, devoting production to patent sides as well as buck skin. A normal working quota is being employed.

PAPER—Paper mills in the vicinity of Three Rivers, Que., are practically all working at full capacity, with largest available working forces.

The Price Brothers Co., Quebec, is arranging for immediate increase in production at its paper mills in the vicinity of Ottawa, Ont., to include the installation of additional equipment. It is purposed to develop a capacity of 200 tons a day before the close of the year.

The Wayagamack Co., Three Rivers, Que., has advanced production at its local paper mills, and is now giving employment to about 500 men.

The Bathurst Co., Bathurst, N. B., is pushing construction on a new local mill to be used for the manufacture of newsprint, and purposes to have the first unit in service at the earliest possible date. The plant will have a rated capacity of 15,000 tons per annum.

IRON AND STEEL—The Blandon Rolling Mill, Reading, Pa., is planning for the immediate resumption of operations at its local mill, following an idle period of about 24 months. Employment will be given to 125 workers.

The Colorado Fuel & Iron Co., Denver, Colo., has blown in two additional blast furnaces at its plant at Pueblo, Colo., giving employment to a large increased working force.

The American Steel & Wire Co., Anderson, Ind., has placed its local mills on a double turn, giving employment to approximately 600 men.

The La Belle Iron Works, Steubenville, O., has blown in its No. 2 furnace, following a shut down for a number of months. A total of 8 sheet mills have also been placed in service after an idle period of about 2 months. The units will be operated at capacity.

The Carnegie Steel Co. is making ready for operation at its Bellaire, O., plant and has issued orders for necessary repairs and improvements. The company is running full at its Edgar Thomson Works in the Pittsburgh, Pa., district, as well as at its other mills in this section.

The Shenango Furnace Co., Sharon, Pa., has completed the remodeling of its No. 1 furnace, and the stack is again in blast. The capacity has been increased from 350 to 500 tons per day.

The Republic Iron & Steel Co., Youngstown, O., is maintaining full operations at its eight furnaces in the Mahoning Valley section, and will continue on this basis for some time to come. The company is dismantling its plant in the vicinity of Sharpsville, Pa., and will remove the equipment to another location.

The Newton Steel Co., Newton Falls, O., is arranging for the immediate operation of three of its eight new sheet mills, recently completed. The five other mills will commence rolling within the next 60 days.

The United States Steel Corporation is operating at 100 per cent at its bar mills in the Youngstown, O., district.

METALS—The National Lead Co., New York, is operating at full capacity at its different plants under a day and night schedule, giving employment to a large working force.

The Susquehanna Casting Co., Wrightsville, Pa., has advanced the wages of employees 5 per cent, effective at once. The Riverside Casting Co., with plant at the same place, has made a similar advance.

The Utah Copper Co., Salt Lake City, Utah, is operating at full capacity at its plants at Magna and Bingham. The company is said to be producing more metal at the present time than at any other period during the past 4 years.

MISCELLANEOUS—The Prince Metallic Paint Co., Bowmanstown, Pa., is increasing production at its local plant, and has adopted a day and night working shift, giving employment to more workers.

The Shore Fertilizer Mfg. Co., Plant City, Fla., is completing the construction of a new local plant and plans to place the mill in service before the close of the month.

The Federal Sugar Refining Co., New York, is arranging for the immediate resumption of operations at its mill at Yonkers, N. Y., which has been idle for about 8 weeks past. The refinery will give employment to approximately 1,200 men.

A total of 104 sugar mills in Cuba are now in operation, as compared with 54 mills at this same time a year ago.

The Boston Hose & Rubber Co., Boston, Mass., is advancing production at its plant. During the last quarter of 1922 the output averaged 25 per cent more than at any other 3 months' period in the history of the company.

Sanitary ware plants at Trenton, N. J., are increasing production, and adding to their working forces.

Capital Increases, Etc.

THE RUMFORD CHEMICAL WORKS, INC., Providence, R. I., has filed notice of increase in capital from $1,250,000 to $2,000,000.

THE BEAVER FALLS ART TILE CO., Beaver Falls, Pa., has arranged for an increase in capital from $80,000 to $200,000.

THE JONATHAN BARTLEY CRUCIBLE CO., Oxford St., Trenton, N. J., has filed notice of increase in capital from $125,000 to $500,000.

THE HART GLASS MFG. CO., Dunkirk, Ind., has increased its capital from $300,000 to $500,000 for general expansion.

THE AMERICAN PRINTING INK CO., 2324 West Kinzie St., Chicago, Ill., has arranged for an increase in capital from $100,000 to $350,000.

New Publications

BOOKS

FOOD PRODUCTS FROM AFAR. By *E. H. S. Bailey* and *H. S. Bailey*. 285 pages, over 50 illustrations. Price $3. Published by the Century Co., New York City.

Although written by chemists, this book is offered as a popular treatise of general interest on the subject of how and where our country gets its food. It is a work of popular interest that may be somewhat enhanced to chemists in view of the fact that the senior author is professor of chemistry in the University of Kansas, while the junior author, his son, is chief chemist for the Southern Cotton Oil Co.

PAMPHLETS, ETC.

A FEW SUGGESTIONS TO MCGRAW-HILL AUTHORS is the title of a 20-page pamphlet recently issued by the McGraw-Hill Book Co., Inc., 307 Seventh Ave., New York. It is designed to give prospective authors information that will enable them to prepare better manuscripts and save both themselves and the publishers time and unnecessary expense.

DENTAL FILLING ALLOYS is the title of a treatise by N. K. Garhart, of the Garhart Dental Specialty Co., Boston, Mass.

THE ENGINEERING EXPERIMENT STATION of Purdue University, Lafayette, Ind., has issued a bulletin, No. 9, on "The Production of Nitric Oxides and Ozone," by K. B. McCochron and R. H. George. Copies may be obtained by writing to the director, Dean Potter.

THE SECRETARY OF COMMERCE, Washington, D. C., has issued his tenth annual report, for 1922.

THE FEDERAL BOARD FOR VOCATIONAL EDUCATION, Washington, D. C., has issued its sixth annual report to Congress, for 1922.

THE IMPERIAL INSTITUTE, London, England, has issued a booklet on "Molybdenum Ores," by R. H. Rastall. Price 5s., net.

THE U. S. DEPARTMENT OF AGRICULTURE, Washington, D. C., has issued Parts I and II, "List of Workers in Subjects Pertaining to Agriculture"; Bull. 1108, on "Tables for the Microscopic Identification of Inorganic Salts," by William H. Fry; Bull. 1122, on "Absorption by Colloidal and Non-colloidal Soil Constituents," by M. S. Anderson, W. H. Fry, P. L. Gile, H. E. Middleton and W. O. Robinson; Circular 233, on "Motion Pictures of the U. S. Department of Agriculture."

THE UNIVERSITY OF ILLINOIS has issued Bull. 131, on "A Study of Air-Steam Mixtures," by Leroy A. Wilson with Charles Russ Richards; Bull. 132, on "A Study of Coal Mine Haulage in Illinois," by H. H. Stock, J. R. Fleming and A. J. Hoskin; Bull. 133, "A Study of Explosions of Gaseous Mixtures," by A. P. Kratz and C. Z. Rosecrans.

THE IMPERIAL MINERAL RESOURCES BUREAU, London, England, has issued booklets on "Nickel," "Iron Ore" and "Coal, Coke and Byproducts," priced at 1s. 6d, 6s. and 7s., respectively.

NEW BUREAU OF MINES PUBLICATIONS: Twelfth Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1922; Bull. 167, Coal-Dust Explosion Tests in the Experimental Mine 1913 to 1918, inclusive, by George S. Rise, L. M. Jones, W. L. Egy and H. P. Greenwald; Bull. 188, Lessons From the Granite Mountain Shaft Fire, Butte, by Daniel Harrington; Bull. 209, Fusibility of Ash From Coals of the United States, by W. A. Selvig and A. C. Fieldner; Tech. Paper 265, Mesothorium, by Herman Schlundt; Tech. Paper 303, Value of Coke, Anthracite and Bituminous Coal for Generating Steam in a Low-Pressure Cast-Iron Boiler, by John Blizard, James Neil and F. C. Houghten; Tech. Paper 306, Operation and Maintenance of Electrical Equipment Approved for Permissibility by the Bureau of Mines, by L. C. Ilsley; Tech. Paper 308, Analysis of Kentucky Coals; Tech. Paper 318, Coke-Oven Accidents in the United States During the Calendar Year 1921, by William W. Adams; Reports of Investigations Serial No. 2416, Properties of Typical Crude Oils From the Producing Fields of Southern Louisiana and Southern Texas, by N. A. C. Smith, A. D. Bauer and N. F. LeJeune; Serial 2406, on Titanium, by R. J. Anderson; Serial 2410, on Contraction and Shrinkage of Non-Ferrous Alloys as Related to Casting Practice, by Robert J. Anderson.

THE COLONIAL SUPPLY CO., Pittsburgh, Pa., is issuing the "Colonial Soldier Almanac for 1923."

New Companies

THE CHAREX CHEMICAL CO., Rochester, N. Y., care of Charles E. Bostwick, Insurance Bldg., Rochester, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are H. C. and H. M. Williamson.

THE STEARNS & CULVER SALT CO., Ludington, Mich., has been incorporated with a capital of $300,000, to manufacture chemical salts and kindred products. The incorporators are E. E. Barthell, W. T. Culver and W. A. Spencer, Ludington. The last noted represents the company.

THE CAPITOL BLOCK & BRICK CO., Trenton, N. J., has been incorporated with a capital of $50,000, to manufacture brick, tile, blocks and other burned clay products. The incorporators are Peter J. and Paul N. Jachetti, 436 Bert Ave., Trenton. The last noted represents the company.

THE HERCULES OIL CO., 4650 Iowa St., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture lubricating oils and affiliated products. The incorporators are Henry J. Brandt, Lawrence A. Cohen and A. L. Rittenberg.

THE J. B. NEWTON TURPENTINE CO., Hillsdale, Miss., has been incorporated with a capital of $100,000, to manufacture turpentine and kindred products. The incorporators are J. B., R. M. and J. R. Newton, all of Hillsdale.

CRANE & CO., INC., Dalton, Mass., has been incorporated with a capital of $3,000,000, to manufacture paper products, succeeding the company of the same name with local mills. Reuben C. Pierce is president, and Payson E. Little, treasurer.

THE FRANKS CHEMICAL CO., Brooklyn, N. Y., has been incorporated with a capital of $30,000, to manufacture chemicals, soaps, etc. The incorporators are J. M. Franks, P. M. Lah and A. M. Rosenthal. The company is represented by Davis, Siegel & Nathan, Broadway and 34th St., New York, N. Y.

THE CHICAGO JAPANNERS, INC., 1160 West 22nd St., Chicago, Ill., has been incorporated with a capital of $150,000, to manufacture paints, oils, varnishes, etc. The incorporators are Thomas P. McVicker and William J. and G. A. Miskella.

THE STATE LINE CHEMICAL CORP., Bristol, Va., has been incorporated with a capital of $30,000, to manufacture chemicals and chemical byproducts. The incorporators are G. C. Cole, M. T. Repass, and Joseph A. Caldwell, all of Bristol.

THE DUTCHESS COUNTY CHEMICAL CO., Jersey City, N. J., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws, with capital of $600,000, to manufacture washing powders, cleansers, and other chemical compounds. The incorporators are H. C. Schuckhaus, Jersey City; M. A. Kerin, New York; and A. H. Wylie, Washington, D. C.

THE LUCAS BRICK CO., Portland, Ore., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. Moses M. Lucas is president and treasurer and Brighton E. Lucas, clerk and representative, both of Portland.

THE HENNETT METAL TREATING CO., West Hartford, Conn., has been incorporated with a capital of $50,000, to operate a metal-treating plant. The incorporators are H. R. Barker, A. J. German and A. L. Davis, all of Waterbury, Conn.

THE KISKI LIME PRODUCTS CO., care of the Corporation Trust Co. of America, du Pont Building, Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $50,000, to manufacture lime and kindred products.

THE CENTRAL OIL CO., El Dorado, Ark., has been incorporated with a capital of $1,000,000, to manufacture petroleum products. The incorporators are Patrick Marr, W. S. Eakens and R. G. Ferrell, all of El Dorado.

THE DE LONG-KENDRICK CO., Newark, N. J., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture metal alloys. The incorporators are Louis DeLong, Richard B. Downing and Kenneth A. Depew, 345 Halsey St., Newark. The last noted represents the company.

J. B. CHAPPELL, INC., Philadelphia, Pa., has been incorporated with a capital of $10,000, to manufacture paints, varnishes, etc. Walter Boshart, Roxborough, Philadelphia, is treasurer, and represents the company.

THE HOFFMAN BROTHERS TANNING CO., 4701 Grand Ave., Chicago, Ill., has been incorporated with a capital of $250,000, to manufacture leather products. The incorporators are Olaf C. and Anton R. Hoffman, and Carl Peterson.

THE NATIONAL SPEEDWAY REFINING CO., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under state laws with a capital of $150,000, to manufacture refined oil products.

THE FIELD PRODUCTS CORP., New York, N. Y., care of M. Brandt, attorney, 276 Fifth Ave., New York, representative, has been incorporated with a capital of $30,000, to manufacture chemicals and chemical byproducts. The incorporators are W., D. and H. J. Greenfield.

THE WULBERN FERTILIZER CO., Charleston, S. C., has been incorporated with a capital of $150,000, to manufacture commercial fertilizer products. E. N. Wulbern is president and treasurer; and William E. Jones, secretary, both of Charleston.

THE LIBERTY MIRROR WORKS, INC., Pittsburgh, Pa., has been incorporated with a capital of $150,000, to manufacture mirrors, glass products, etc. William H. Colbert, 6615 Kelly St., Pittsburgh, is treasurer and representative.

THE SMACKOVER VALLEY OIL CO., Camden, Ark., has been incorporated with a capital of $250,000, to manufacture petroleum products. A. M. Sutton is president and general manager; and W. M. Worthen, secretary, both of Camden.

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 8 and 9, 1923.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

CANADIAN PULP AND PAPER ASSOCIATION will meet at the Ritz-Carlton Hotel, Montreal, Jan. 25 and 26.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Feb. 9—American Electrochemical Society (in charge). Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.